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Improving nurse staffing measures: Discharge day measurement in "adjusted patient days of care"

Lynn Y. Unruh
University of Central Florida

Myron D. Fottler
University of Central Florida

Laura L. Talbott

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Previous research cannot account for the discrepancy between registered nurse (RN) reports of understaffing and studies showing slight improvement. One reason may be that "adjusted patient days of care"(APDC) underestimates patient load. Using data from all Pennsylvania acute care general hospitals for the years 1994 through 1997, we found that APDC is underestimated by two hours. After adjusting APDC, we examined the difference in nurse staffing over the period 1991–2000 before and after the adjustment. We found a significant difference between unadjusted and adjusted measures. However, when applied to the changes in nurse staffing between 1991 and 2000, the difference was not enough to account for the discrepancy between reports and data. Other measurement and conceptual problems may exist in terms of patients' increasing acuity levels, patients' declining lengths of stay and the associated greater proportion of nurse time devoted to admission and discharge, and lack of recent data in some empirical studies.

For a number of years, health service researchers have found it difficult to objectively verify the growing perception of an increase in registered nurse (RN) patient load in hospitals (Aiken, Sochalski, and Anderson 1996; Anderson and Kohn 1996; Spetz 1998, 2000; Buerhaus and Staiger 1999; Bond and Raehl 2000; Kovner, Jones, and Gergen 2000). The problem persists even when reports of understaffing and shortages abound (Shindul-Rothschild, Berry, and Long-Middleton 1996; Wunderlich, Sloan, and Davis 1996; Brannon 1996; Peterson 1999; Wakefield 2001; Aiken et al. 2001).

One explanation is that patient acuity has risen and accounts for the impression of higher workloads (Aiken, Sochalski, and Anderson 1996). When patient load is adjusted for acuity or case mix, researchers find that RN workload has stayed about the same (Aiken, Sochalski, and Anderson 1996; Spetz 2000) or increased (Unruh 2002, 2003b) in the 1990s. Yet RNs report that they are taking care of increased numbers of patients, *in addition* to facing higher levels of patient acuity (Shindul-Rothschild, Berry and Long-Middleton 1996; Aiken et al. 2001; Federation of Nurses and Health Professionals 2001). So the increase in acuity does not fully account for the reports of higher patient load.

Lynn Y. Unruh, Ph.D., *is an assistant professor of health services administration, and* ***Myron D. Fottler, Ph.D.,*** *is a professor and director of health services administration programs, both in the Department of Health Professions, College of Health and Public Affairs, University of Central Florida.* ***Laura L. Talbott, M.S., C.H.E.S.,*** *is a doctoral student in the Department of Health Promotion, Education, and Behavior, Norman J. Arnold School of Public Health, University of South Carolina, Columbia. Address correspondence to Prof. Unruh at Department of Health Professions, College of Health and Public Affairs, (HPA2), University of Central Florida, Orlando, FL 32816. Email: Lunruh@mail.ucf.edu*

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Another explanation is that the years being studied lag behind those where the changes are perceived (Kovner, Jones, and Gergen 2000). For the most part, studies measuring nurse staffing only assess years up to the mid-1990s. Yet a recent assessment of staffing in California up to 1998 (Spetz 2000), and one in Pennsylvania up to 2000 (Unruh 2003b) still do not show increases in RN patient load. Other explanations focus on conceptual issues, such as the impact of a 29% decline in hospital licensed practical nurses (LPNs) in the 1990s, which may contribute to increased RN workload because RNs have to take up the work of the missing LPNs (Unruh 2003a,b).

It is also possible that the difficulty in establishing an increase in RN patient load is due to changes in the validity of the measures. One concern relates to measuring bedside nurses in hospitals. It has been reported that the proportion of RNs employed in administrative, educational, and other non-bedside jobs in hospitals has been increasing (Spratley et al. 2002). Since most measures used to count bedside nurses do not adequately distinguish between RNs at the bedside and those in other roles, there will be an inflationary bias in the assessment of the numbers of RNs at the bedside over time. Another nurse measurement issue is the failure of most data to distinguish between inpatient and outpatient nurses. This causes difficulty if workload measures do not also include both inpatients and outpatients, and raises the issue of how to account for outpatient care. As the proportion of outpatient care, and of the nurses assigned to care for outpatients, increases over time, any problems with this measurement could lead to increasingly less valid measures of RN patient load.

Another concern relates to changes in the validity of patient load indicators. "Adjusted patient days of care" (APDC) is a commonly used patient load indicator that measures the number of days of patient care per year in hospitals. It is a number calculated by the American Hospital Association (AHA) based on its Annual Survey of hospitals. This measure is composed of hospital inpatient days of care (the number of patients times their lengths of stay) plus estimated outpatient days of care. Outpatient care is estimated by multiplying the number of inpatient days by the proportion of outpatient to inpatient revenue. In sum, APDC = inpatient days + [inpatient days × (outpatient revenue/inpatient revenue)] (AHA 2000a).

APDC is a useful measure of patient load in a hospital if the nursing staff positions or hours include nurses working in both inpatient and outpatient hospital settings. Several studies evaluating nurse staffing have utilized the measure (Aiken, Sochalski, and Anderson 1996; Kovner, Jones, and Gergen 2000; Spetz 1998, 2000; Unruh 2002, 2003a,b). A potential problem with APDC is with its estimation of outpatient care. Outpatient care is merely an estimate using the ratio of outpatient to inpatient revenue. The actual hours of outpatient care are not known. Another problem with APDC is that it does not count the inpatient's last day in the hospital (unless that day was the same as the admission day, i.e., the patient was in the hospital 24 hours or less). According to the AHA, an inpatient day of care "is a period of service between the census-taking hours on two successive calendar days, the day of discharge being counted only when the patient was admitted the same day" (AHA 2000a).

The convention of counting the admission day but not the discharge day may have been instituted as a weighting mechanism due to the uncertainty of the time of day for both admission and discharge; however, the potential for underestimating workload associated with a patient stay is great. As length of stay has declined over the past decade (AHA 2000b; CDC 2002), a higher percentage of the patient's stay is comprised of the admission and discharge day. Therefore, a higher proportion of APDCs also are comprised of admission and discharge days. In addition, given the trend toward shorter lengths of stay and greater use of hospitalists, patient discharges may be occurring at later hours than in previous years. The APDC measure increasingly may underestimate the "days of care," or at least portions of those days, in hospitals.

A search of key words "APD," "APDC," "adjusted patient days," and "adjusted patient days of care" in health services and nursing article databases (Medline, HealthStar, CINAHL) does not reveal any published studies on the validity of the APDC measure, on issues with the measure, or on any adjustment of the measure. This study aims to examine issues that arise from the discounted discharge day convention employed in APDC calculations, and to assess whether this affects nurse staffing measures. Using four years of patient-level data from Pennsylvania hospitals, we assess whether discounting

the discharge day is warranted as a weighting mechanism. Next, we use 10 years of AHA data on APDC in Pennsylvania hospitals to look at whether the practice of discounting the discharge day significantly alters the measurement of APDC in those years. Using measures of APDC adjusted to include a portion of the discharge day, we assess nursing staff patient load in Pennsylvania hospitals from 1991 to 2000, before and after adjusting the APDC. Finally, we examine whether the change in nursing staff patient load measures makes a significant difference in the trends in staffing over time.

It should be pointed out that the measurement issue regarding adjusted patient days of care is not just an issue in nurse staffing studies. Other research addressing such issues as medical errors or quality of care also may be impacted if the APDC is used in such studies and is understating the actual days of care provided. The measurement problem we address here has significant implications for all types of health services research that relies on an accurate measure of APDC.

Methods

This study examines the justification for and impact of discounting the discharge day when calculating adjusted patient days of care, using data from all general, acute care Pennsylvania hospitals. First, we compare the average number of hours that patients are in the hospital on both their admission and discharge day to the APDC convention of including the admission day only (an assignment, therefore, of 24 hours). We look at whether admission day hours plus discharge day hours are greater than 24 hours. Second, we adjust APDC to account for any discrepancy encountered in our first objective, and we assess whether there is a significant difference in adjusted and unadjusted measures. Third, given significant differences between adjusted and unadjusted APDC, we compare nurse staffing measures using both APDC measures. Fourth, we assess whether the trend over time in nurse staffing utilizing the discharge-day adjusted APDC measure is significantly different than staffing using the usual APDC measure.

Initial patient-level data for the study were the hour of admission and hour of discharge of a patient's stay in the hospital. Initial hospital-level data were the number of discharges per year, APDC per year, and the number of full-time equivalent (FTE) RN, LPN, licensed nurse (RNs + LPNs) and nursing assistant filled positions on June 30th of each year. FTEs are defined by convention as one full-time position or two part-time positions. In our data set from the Pennsylvania Department of Health (PDH), a full-time position could be 30 hours per week or more, while part-time positions were under 30 hours per week. Given this weighting, in which full-time positions could be less than 40 hours, and part-time positions could be more or less than 20 hours, but no more than 30 hours, it is expected that FTEs average out to around 40 hours per week.

The patient admission and discharge hours were obtained from the Pennsylvania Health Care Cost Containment Council (PHC4) for the years 1994–97. For years prior to 1994, data were not available for time of admission and time of discharge. We did not have access to patient-level data after 1997. APDC data for each general, acute care Pennsylvania hospital from 1991 to 2000 were obtained from the American Hospital Association. We acquired the number of discharges and nurse staffing data from the PDH. Due to hospital openings, mergers, and closings, and to missing data for some measures in some hospitals, the number of hospitals included in each analysis varied from year to year, ranging from 213 to 183.

The patient-level measure constructed for the analysis was a calculation of the number of hours patients were in the hospital on their admission and discharge day combined. Admission day hours and discharge day hours were obtained by recoding the original hour of admission and hour of discharge to reflect the number of hours in the admission day from the hour of admission, and the number of hours in the discharge day prior to discharge. The hours of admission and discharge are recorded by each hospital in military time, starting with 00 at midnight, going to 23 at 11 p.m. The convention used for the hospital reporting of the hours is not known. Using the same military time that goes from 00 to 23, the total number of hours in the admission day were coded as "24– the admission hour"; the total number of hours in the discharge day were coded as "discharge hour +1" (an hour was added because the count starts at 0). These two values were added together to produce the total number

Table 1. Average hours of patient care for admission and discharge days in Pennsylvania hospitals, 1994–1997

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Yearly mean
1994	25.48	25.65	25.78	25.70	25.60
1995	25.70	25.81	25.91	25.86	25.82
1996	25.80	25.86	25.98	25.87	25.86
1997	25.83	25.93	25.99	25.98	25.93

of hours the patient was in a hospital on both the admission and discharge day.

After preparing the new measure of the total number of hours for admission and discharge days, a mean of the measure was calculated for each quarter in each year from 1994 to 1997. These results are presented in Table 1.

Based on the results presented in Table 1, which shows that the average number of hours of care for different admission and discharge days is close to 26 hours, we established that the conventional APDC measure underestimates the "days of care" by two hours, or 1/12 of a day of care. This two-hour underestimation is the difference between our calculations of the actual number of hours the patient was in the hospital in both the admission and discharge day and the conventional measure that ignores the discharge day and assumes a 24-hour admission day.

The next step was to create a new APDC measure that improves estimation. To do this, we used the number of discharges in each hospital in each year as a proxy for the discharge days of care. Although this proxy also counts patients who were in the hospital 24 hours or less, these patients were not double counted because they also were included in the calculation of the missing discharge hours (i.e., two hours were missing from each hospital stay, regardless of the length of stay). Table 2 shows that the number of discharges increased from 7,933/hospital in 1991 to 8,796/hospital in 2000.

We added 1/12 of the hospital discharge day of care (two hours) to the APDC in the hospital for the given year. We then assessed the significance of the difference between the old and new measure by conducting paired sample t tests of the mean difference in APDC in each year from 1991 to 2000 (a t-test was performed on the mean difference of the old and new construct in each hospital). Table 3 shows the discharge-days adjusted and unadjusted APDC in Pennsylvania hospitals from 1991 to 2000 together with t values for the significance of the difference in each year. All t values are statistically significant at $p < .0001$ for all years. For each year, the statistical adjustment of 1/12 of a day (two hours) to reflect the reality of each hospital stay resulted in the adjusted APDC being significantly higher than the unadjusted APDC.

Table 2. Discharge days in Pennsylvania hospitals, 1991–2000

	Number of hospitals	Mean number of discharges/hospital	Standard deviation
1991	213	7,933	5,661.76
1992	209	8,099	5,771.35
1993	205	8,268	5,970.10
1994	204	8,231	6,156.01
1995	196	8,139	6,313.99
1996	197	8,183	6,396.64
1997	188	8,079	6,654.54
1998	192	8,337	6,960.09
1999	191	8,284	7,267.45
2000	183	8,796	7,613.22

Following this analysis, the impact of the new measure on nursing staff patient load was assessed by constructing a baseline nursing staff measure composed of the ratio of the nursing staff to original APDC, and a new measure of nursing staff to APDC adjusted for two more hours (1/12 of a discharge day). For both of these measures, the numerator was the number of nursing staff as defined earlier in the initial data. The denominator for the baseline ratio was the original APDC. The denominator for the new measure was APDC adjusted for 1/12 discharge day as described previously. Both of these measures were multiplied by 1,000 to avoid small ratios.

We then assessed the significance of the difference between the old and new measure of nursing staff patient load by conducting paired sample t tests of the mean difference in the measures in each hospital in each year from 1991 to 2000. To examine whether the new measures make a significant difference in the change in nursing staff patient load over time, we performed paired sample t tests of the mean difference in the year-to-year and overall percentage change in nursing staff patient load from 1991 to 2000.

Table 3. Adjusted patient days of care in Pennsylvania hospitals, 1991–2000, before and after adjustment for 1/12 discharge day

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Adjusted patient days of care										
Before adjustment	82,749	86,430	90,408	84,667	81,330	80,135	79,972	83,752	83,953	87,263
After adjustment	83,410	87,104	91,097	85,353	82,008	80,817	80,645	84,461	84,656	88,013
Mean difference	−661	−675	−689	−686	−678	−682	−673	−709	−703	−750
t value	−20.45	−20.29	−19.83	−19.1	−18.05	−17.96	−16.65	−16.31	−15.37	−15.2

Note: All *t* values significant at $p < .0001$.

Results

Table 4 addresses the issue of Pennsylvania hospital staffing ratios per 1,000 APDC before and after discharge day adjustment from 1991 to 2000. The question addressed here is whether adjusting the APDC for 1/12 discharge day makes a significant difference in nurse staffing ratios. We show four measures of nurse staffing: 1) RNs per 1,000 APDC; 2) LPNs per 1,000 APDC; 3) nurse assistants per 1,000 APDC; and 4) licensed nurses (RNs + LPNs) per 1,000 APDC.

Table 4 indicates that the discharge-day adjustment of APDC results in a nurse staffing ratio per 1,000 discharge-day adjusted APDC that is significantly lower than the comparable nurse staffing ratio per unadjusted APDC. These differences were greatest for the ratio of licensed nurses (i.e., RNs + LPNs) per adjusted APDC.

Table 5 shows the percentage change in all nurse staffing ratios per 1,000 APDC (discharge-day adjusted and unadjusted) in Pennsylvania hospitals from 1991 to 2000. The last column on the right shows the total changes in nurse staffing over the entire period before and after adjustment, as well as the differences in the percentage change before and after adjustment, and the statistical significance of these differences (*t* value). All four nurse staffing ratios showed statistically significant differences in the percentage change before and after adjustment. In other words, the percentage change in these ratios was worse after adjustment (i.e., less improvement or more deterioration in staffing ratios). On the other hand, the adjustment did not make a statistical difference in the change in staffing from year to year except for the years 1993–96. Nor did it reverse the direction of change for RNs (from an increase in RNs per 1,000 APDC to a decrease in RNs per 1,000 adjusted APDC) in any year or overall.

Discussion

An evaluation of data in Pennsylvania hospitals from 1994 through 1997 indicates that the current method of calculating the APDC understates the average number of hours of a patient stay by about two hours for each hospital stay. After adjusting APDC based on this finding, the adjusted APDC were significantly higher than the unadjusted APDC. When the adjusted APDC were applied to the nurse staffing ratios, all four measures were significantly lower. When applied to the *changes* in nurse staffing from 1991 to 2000, the adjusted measures produced significantly different yearly changes only for the years 1993–96, and for the period as a whole.

However, the adjusted measures did not reverse RN staffing to show a decrease in RNs per 1,000 APDC. In other words, the difference between traditional methods of measuring nurse staffing per adjusted patient day and our proposed method using the patients' actual times of arrival and departure are very small. The perceived decreased staffing not measured by traditional staffing measures is only partially explained by the gross nature of nurse staffing per adjusted patient day.

Since no previous research has addressed the same question, we are unable to compare our results to comparable studies. While many studies use nurse staffing per adjusted patient day (Aiken, Sochalski, and Anderson 1996; Unruh 2002; Kovner, Jones, and Gergen 2000; Spetz 2000), none of these previous studies has addressed the adjusted patient day measurement issue discussed here. It appears that while the (more accurate) measure of patient days results in an increased workload and reduced nurse staffing ratios, the order of magnitude of the change is not large. If previous research on nurse staffing had used our adjusted measure of patient days, the results probably would not have been altered significantly.

Table 4. Nursing staff levels/1,000 APDC in Pennsylvania hospitals, 1991–2000, before and after adjustment for 1/12 discharge day

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RN/1,000 APDC										
Before adjustment	2.68	2.78	2.76	2.84	2.88	2.94	2.92	2.89	2.99	2.87
After adjustment	2.66	2.76	2.73	2.81	2.86	2.91	2.89	2.87	2.97	2.85
Mean difference	−.02	−.023	−.03	−.025	−.02	−.027	−.026	−.02	−.02	−.02
t value	−33.71	−32.41	−29.48	−30.1	−27.99	−27.05	−25.1	−25.25	−17.16	−18.93
LPN/1,000 APDC										
Before adjustment	.60	.59	.55	.54	.52	.51	.48	.46	.45	.43
After adjustment	.60	.59	.55	.53	.51	.50	.48	.46	.45	.43
Mean difference	.00	.00	.00	−.01	−.01	−.01	.00	.00	.00	.00
t value	−19.59	−19.07	−17.70	−18.65	−18.59	−19.04	−18.66	−17.81	−17.26	−15.89
NA/1,000 APDC										
Before adjustment	.58	.59	.58	.58	.60	.61	.64	.65	.61	.65
After adjustment	.58	.59	.57	.58	.59	.61	.64	.64	.60	.64
Mean difference	.00	.00	−.01	.00	−.01	.00	.00	−.01	−.01	−.01
t value	−18.92	−18.15	−17.83	−15.66	−15.77	−17.62	−13.32	−19.30	−15.27	−9.39
Licensed nurses/1,000 APDC										
Before adjustment	3.28	3.37	3.31	3.38	3.40	3.45	3.40	3.36	3.45	3.30
After adjustment	3.26	3.34	3.28	3.35	3.37	3.42	3.37	3.33	3.42	3.27
Mean difference	−.02	−.03	−.03	−.03	−.03	−.03	−.03	−.03	−.03	−.03
t value	−35.28	−34.12	−30.32	−31.82	−29.84	−29.39	−27.09	−27.01	−18.50	−20.06

Notes: All *t* values significant at $p < .0001$. RN = registered nurse; LPN = licensed practical nurse; NA = nursing assistant; licensed nurses = RNs + LPNs.

Table 5. Percentage change in nursing staff/1,000 APDC in Pennsylvania hospitals, 1991–2000, before and after adjustment for 1/12 discharge day

	1991–92	1992–93	1993–94	1994–95	1995–96	1996–97	1997–98	1998–99	1999–2000	1991–2000
RN/1,000 APDC										
Before adjustment	4.19	3.26	3.75	3.48	2.32	1.68	1.26	.07	−.73	7.24
After adjustment	4.19	3.26	3.70	3.44	2.30	1.69	1.26	.09	−.76	7.18
Mean difference	.00	.00	−.05	−.04	−.02	.01	.00	.02	−.03	−.06
t value	.26	−.21	−4.89****	−4.51****	−2.36*	.64	−.53	.46	−1.64	−2.65**
LPN/1,000 APDC										
Before adjustment	5.13	−3.08	−1.46	−1.65	−1.17	.61	−1.58	−4.07	−4.35	−18.70
After adjustment	5.13	−3.09	−1.51	−1.68	−1.19	.62	−1.59	−4.05	−4.37	−18.74
Mean difference	.00	−.01	−.04	−.03	−.02	.01	−.01	.02	−.02	−.04
t value	.22	−.74	−4.54****	−4.22****	−2.71**	.22	−.40	.32	−1.54	−2.35*
NA/1,000 APDC										
Before adjustment	13.61	3.92	6.01	11.58	8.40	10.22	8.76	.81	9.73	32.95
After adjustment	13.62	3.92	6.00	11.57	8.40	10.22	8.76	.83	9.69	32.78
Mean difference	.01	.00	−.01	−.01	.00	.00	.00	.02	.04	−.17
t value	.65	.15	−3.88***	−4.14****	−2.07*	1.08	−.60	1.45	−1.29	−1.82*
Licensed nurses/1,000 APDC										
Before adjustment	−3.10	1.99	2.26	2.80	1.60	.64	.58	−.39	−1.20	−.11
After adjustment	−3.07	1.99	2.21	2.77	1.58	.64	.58	−.38	−1.23	−.18
Mean difference	.03	.00	−.05	−.03	−.02	.00	.00	.01	−.03	−.07
t value	.25	−.29	−4.49****	−4.49****	−2.43*	.6	−.58	.70	−1.65	−2.70**

Note: RN = registered nurse; LPN = licensed practical nurse; NA = nursing assistant; Licensed nurses = RNs + LPNs.
* $p < .1$
** $p = .01$
*** $p = .001$.
**** $p = .0001$.

Thus, the gap between RN perceptions of inadequate and declining staffing (patient overload), and objective studies showing a slight improvement in RN staffing over time still is not resolved. Perhaps data more recent than ours (i.e., data for years 2001 and 2002) might show declining RN staffing. Of course, this paper does not address the issue of increases in inpatient acuity. To the extent that patient acuity is increasing, a stable RN staff level would imply increasing nurse workloads over time. Other research addresses the issue of the adequacy of nurse staffing in light of high patient acuity levels (Unruh 2002, 2003b). However, as we discussed in the introduction, increases in nursing *workload* (taking into account patient acuity) do not explain perceptions of increases in *patient load*.

A two-hour difference in the "official" average patient length of stay and the actual length of stay may seem insignificant as a practical matter. If the actual patient length of stay is two hours longer than officially reported, how much difference does this make in terms of nurse staffing levels and patient loads or workloads? The answer is that it makes a greater and greater practical difference as average length of stay declines over time (CDC 2002). As length of stay falls, the proportion of the patient stay represented by two hours increases. Assuming no decline in inpatient acuity, the intensity of nursing care carried out in the two hours must increase also. As intensity of nursing care increases, so does nursing staff workload. The increase in workload would occur *in addition to* the workload increase due to patient acuity.

In addition, a glance at Table 1 shows that the number of hours not accounted for in APDC is growing. Apparently, as *per day* length of stay is falling, *per hour* length of stay in the admission and discharge days is rising. The number of hours that patients are in the hospital on their admission and discharge days is increasing. At the rate of growth indicated in Table 1, unaccounted hours already may be greater than two hours per patient stay. Even if this underestimation of patient stay did not result in highly inaccurate measures of utilization and nurse staffing in this study, as the underestimation increases, it surely will result in inaccurate measures of these factors in the future.

The increasing turnover of patients also could explain the gap between nurse perceptions of increased workload and studies that have been unable to document the perceived increase. Each admission and discharge require nurse time to admit the patient, assess the patient, treat the patient, and discharge the patient. These admission and discharge tasks must be done whether the patient is in the hospital for three or five days. The declining average lengths of patient stays result in nurses having to perform these duties more frequently, thus increasing their workloads.

Thus, nurse perceptions of overstaffing not indicated by empirical studies may be due to some combination of the following: 1) the measurement problem of understating the patient day by about two hours per day documented in the present study; 2) high and increasing acuity levels for hospital inpatients due to more procedures being shifted to outpatient care; 3) the greater proportion of nurse time devoted to admissions and discharges due to declining length of stay discussed previously; and 4) the time gap between the empirical staffing data and nurse perceptions (i.e., the empirical studies do not include data for the past three years). The relative significance of each of these factors is unclear. Nevertheless, each separately and together have the potential to distort our empirical results, particularly if their impact is increasing over time. For the first three factors, this appears to be the case (Aiken et al. 2001; AHA 2000a,b; CDC 2002; FNHP 2001; Unruh 2002, 2003a).

This study has limitations due to many of the measurement issues with nursing staff and APDC mentioned in the introduction: our data have the same validity issues regarding actual counts of nurses at the bedside, of nurses in inpatient versus outpatient settings, and of the number of inpatient or outpatient days of care. In addition, the accuracy of the admission and discharge hours in the data is not known. The convention that the hospitals use to record the time of admission is not explicit. If patients come in through the emergency room (ER), is the inpatient admission hour when they leave the ER for the floor or unit? If they are a direct admit, how is their inpatient arrival time recorded? The discharge hour is more straightforward, since it usually is recorded as the time at which the patient left the nursing unit upon discharge. Therefore, while admission hour accuracy is a question, the discharge hour should be fairly accurate since it is taken from the time

put down by the nurse as to when the patient actually left the hospital.

Another question is whether nursing care actually continues up to the hour of discharge. This has not been studied empirically, but some observations may be made. First, nursing care to each patient generally is not continuous. In other words, nurses have several patients simultaneously, and care for each patient sporadically. The greater the number of patients a nurse has, the fewer minutes per shift is spent with each patient. Therefore, a nurse may get the patient "ready to go" a couple hours before the patient leaves, but that act could just as well be performed at the last few minutes the patient is in the hospital without any impact on the assessment of patient load. When the patient is made ready for discharge is up to the nurse and his workload and priorities.

Second, many nurses seem to experience a last minute rush to discharge, where they must quickly educate the patient regarding home care, or complete detailed transfer paperwork and give a transfer report to the receiving institution. This lends credence to an evaluation of the discharge day, and the last few hours before discharge, as being a time of intensive work for the nurse. Finally, nurses must finish chart paperwork *after* the patient has been discharged, so their work continues even *after* the discharge hour recorded in the administrative record.

Future research should replicate this study using different samples—preferably a national sample—to validate whether the underestimation of APDC found in Pennsylvania hospitals occurs on a broader and ongoing, perhaps even growing, basis. Studies then should examine whether the understatement of nurse workload and overstatement of nurse staffing ratios found in this study of Pennsylvania hospitals from 1991 to 2000 is found elsewhere. While it is possible no discrepancy may be found elsewhere, it is also possible that discrepancies found elsewhere may be greater or less than those reported here. Once we have a body of evidence, then we will be in a position to determine what adjustments (if any) are needed in the measure of APDC and in nurse staffing research. Verification of these initial results is a necessary prerequisite to policy analysis in this area.

Future research also should explore the other issues with nurse staffing and patient load measures discussed in this study. We need to assess whether bedside RNs are being counted properly, or whether the numbers are inflated due to inclusion of non-bedside RNs in an institution. We need to know whether patient load is being adequately assessed through the outpatient estimator in APDC.

Nurse staffing researchers also should study nurse staffing in more recent years, adjust nurse workloads for patient acuity levels, and explore the incorporation of nurse workload adjustments based upon the higher proportion of nurse time devoted to admission and discharge as discussed earlier. More specifically, researchers need to examine the degree to which the declining average length of inpatient stay has increased nurse workloads as a result of the greater proportion of nurse time devoted to admission and discharge.

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