

TRANSFORMING HEALTHCARE

The Evolving Role of the Pediatric Nurse Practitioner in Hospital Medicine

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BACKGROUND: This program evaluation sought to compare cost and pediatric patient outcomes among a pediatric nurse practitioner (PNP) hospitalist team, a combined PNP/doctor of medicine (MD) team, and 2 resident teams without PNPs.

METHODS: Administrative and electronic medical record data from July 1, 2009 to June 30, 2010 was retrospectively reviewed from Children's Hospital Colorado inpatient medical unit and inpatient satellite sites in the Children's Hospital network of care (NOC). The top 3 All Patient Refined Diagnosis Related Groups (APR-DRG) admission codes bronchiolitis and respiratory syncytial virus (RSV) pneumonia, pneumonia not elsewhere classified (NEC), and asthma were selected for this analysis. Inpatient records representing these APR-DRG admission codes were reviewed (N = 1664). Measures included adherence with relevant clinical care guidelines (CCGs), length of stay (LOS), and cost of care. Chi square, t

tests, and analysis of variance were used to analyze between-group differences.

RESULTS: Approximately 20% of these admissions were on the PNP team, 45% were on the resident teams, and 35% were on the PNP/MD team in the NOC. PNP adherence to CCGs was comparable to resident teams for selected measures. There was no significant difference in LOS among the PNP team, the PNP/MD team, and the resident teams. The direct cost of patient care per encounter provided by the PNP team was significantly less than the PNP/MD team and the resident teams.

CONCLUSIONS: There is evidence to suggest that PNP hospitalists provide inpatient care comparable to resident teams at a lower cost for patients with uncomplicated bronchiolitis, pneumonia, and asthma. *Journal of Hospital Medicine* 2014;9:261–265. © 2014 Society of Hospital Medicine

The Accreditation Council for Graduate Medical Education implemented rules limiting work hours for residents in 2003 and 2011, decreasing the availability of residents as providers at teaching hospitals.¹ These restrictions have increased reliance on advance practice providers (APPs) including nurse practitioners (NPs) and physicians' assistants in providing inpatient care. The NP hospitalist role includes inpatient medical management, coordination of care, patient and staff education, and quality improvement activities.² The NP hospitalist role has expanded beyond a replacement for reduced resident work hours, adding value through resident teaching, development of clinical care guidelines (CCGs), continuity of care, and familiarity with inpatient management.³ The NP hospitalist role has been shown to improve the quality, efficiency, and cost effectiveness of inpatient care.^{4,5}

Favorable quality and cost measure results have been documented for adult NP hospitalists compared to housestaff, including improved patient outcomes, increased patient and staff satisfaction, decreased length of stay (LOS) and cost of care, and improved access to care.⁶ These findings are supported by NP inpatient program evaluations at several academic medical centers, which also show increased patient and family satisfaction and improved communication between physicians, nurses, and families.^{6–8} One study demonstrated that collaborative care management of adult medical patients by a hospitalist physician and advanced practice nurse led to decreased LOS and improved hospital profit without changing patient readmission or mortality.⁹ Although there is a growing body of evidence supporting the quality and cost effectiveness of the NP hospitalist role in adult inpatient care, there are little published data for pediatric programs.

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METHODS

The pediatric nurse practitioner (PNP) hospitalist role at Children's Hospital Colorado (CHCO) was initiated in 2006 to meet the need for additional inpatient providers. Inpatient staffing challenges included decreased resident work hours as well as high inpatient volume during the winter respiratory season. The PNP hospitalist providers at CHCO independently

manage care throughout hospitalization for patients within their scope of practice, and comanage more complex patients with the attending doctor of medicine (MD). The PNPs complete history and physical exams, order and interpret diagnostic tests, perform procedures, prescribe medications, and assist with discharge coordination. Patient populations within the PNP hospitalist scope of practice include uncomplicated bronchiolitis, pneumonia, and asthma.

The hospitalist section at CHCO's main campus includes 2 resident teams and 1 PNP team. The hospitalist section also provides inpatient care at several network of care (NOC) sites. These NOC sites are CHCO-staffed facilities that are either freestanding or connected to a community hospital, with an emergency department and 6 to 8 inpatient beds. The PNP hospitalist role includes inpatient management at the CHCO main campus as well as in the NOC. The NOC sites are staffed with a PNP and MD team who work collaboratively to manage inpatient care. The Advanced Practice Hospitalist Program was implemented to improve staffing and maintain quality of patient care in a cost-effective manner. We undertook a program evaluation with the goal of comparing quality and cost of care between the PNP team, PNP/MD team, and resident teams.

Administrative and electronic medical record data from July 1, 2009 through June 30, 2010 were reviewed retrospectively. Data were obtained from inpatient records at CHCO inpatient medical unit and inpatient satellite sites in the CHCO NOC. The 2008 versions 26 and 27 of the 3M All Patient Refined Diagnosis-Related Groups (APR-DRG) were used to categorize patients by diagnosis, severity of illness, and risk of mortality.^{10,11} The top 3 APR-DRGs at CHCO, based on volume of inpatient admissions, were selected for this analysis, including bronchiolitis and RSV pneumonia (APR-DRG 138), pneumonia NEC (APR-DRG 139), and asthma (APR-DRG 141) (N = 1664). These 3 diagnoses accounted for approximately 60% of all inpatient hospitalist encounters and comprised 78% of the PNP encounters, 52% of the resident encounters, and 76% of the PNP/MD

encounters. APR-DRG severity of illness categories include I, II, III, and IV (minor, moderate, major, and extreme, respectively).¹² Severity of illness levels I and II were used for this analysis. Severity III and IV levels were excluded due to lack of patients in these categories on the PNP team and in the NOC. We also included observation status patients. The PNP team accounted for approximately 20% of the inpatient encounters, with 45% on the resident teams and 35% on the PNP/MD team in the NOC (Table 1).

The PNP hospitalist program was evaluated by comparing patient records from the PNP team, the PNP/MD team, and the resident teams. Evaluation measures included compliance with specific components of the bronchiolitis and asthma CCGs, LOS, and cost of care.

Outcomes Measured

Quality measures for this program evaluation included compliance with the bronchiolitis CCG recommendation to diagnose bronchiolitis based on history and exam findings while minimizing the use of chest x-ray and respiratory viral testing.¹³ Current evidence suggests that these tests add cost and exposure to radiation and do not necessarily predict severity of disease or change medical management.¹⁴ This program evaluation also measured compliance with the asthma CCG recommendation to give every asthma patient an asthma action plan (AAP) prior to hospital discharge.¹⁵ Of note, this evaluation was completed prior to more recent evidence that questions the utility of AAP for improving asthma clinical outcomes.¹⁶ There were no related measures for pneumonia available because there was no CCG in place at the time of this evaluation.

Outcomes measures for this evaluation included LOS and cost of care for the top 3 inpatient diagnoses: bronchiolitis, asthma, and pneumonia. LOS for the inpatient hospitalization was measured in hours. Direct cost of care was used for this analysis, which included medical supplies, pharmacy, radiology, laboratory, and bed charges. Nursing charges were also included in the direct cost due to the proximity of nursing cost to the patient, versus more distant costs

TABLE 1. Distribution of Patients on the PNP, PNP/MD, and Resident Teams by APR-DRG and Patient Type/Severity of Illness

Distribution of Patients	Patient Type/Severity of Illness	NP	Resident	PNP/MD
Bronchiolitis	Observation	26 (23%)	32 (28%)	55 (49%)
	Severity I	93 (29%)	77 (24%)	151 (47%)
	Severity II	49 (24%)	95 (47%)	60 (29%)
Asthma	Observation	7 (14%)	23 (45%)	21 (41%)
	Severity I	48 (14%)	191 (57%)	97 (29%)
	Severity II	19 (12%)	106 (66%)	35 (22%)
Pneumonia	Observation	6 (22%)	12 (44%)	9 (34%)
	Severity I	33 (17%)	68 (35%)	93 (48%)
	Severity II	37 (14%)	152 (59%)	69 (27%)

NOTE: N = 1664. Abbreviations: APR-DRG, All Patient Refined Diagnosis-Related Groups; MD, doctor of medicine; NP, nurse practitioner; PNP, pediatric nurse practitioner.

such as infrastructure or administration. Hospitalist physician and NP salaries were not included in direct cost analysis. Outcomes were compared for the PNP team, the resident teams, and the PN/MD team in the NOC.

Analysis

Patients were summarized by diagnosis-related groups (APR-DRG) and severity of illness using counts and percentages across the PNP team, resident teams, and the PNP/MD team in the NOC (Table 1). LOS and direct cost is skewed, therefore natural log transformations were used to meet normal assumption for statistical testing and modeling. Chi squared and *t* tests were performed to compare outcomes between the PNP and resident physician teams, stratified by APR-DRG. Analysis of variance was used to analyze LOS and direct cost for the top 3 APR-DRG admission codes while adjusting for acuity. The outcomes were also compared pairwise among the 3 teams using a linear mixed model to adjust for APR-DRG and severity of illness, treating severity as a nested effect within the APR-DRG. Bonferroni corrections were used to adjust for multiple comparisons; a *P* value <0.017 was considered statistically significant. Post hoc power analysis was completed for the analysis of bronchiolitis chest x-ray ordering, even though the sample size was relatively large (PNP team 128, resident team 204) (Table 1). There was a 7% difference between the PNP and resident groups, and the power of detecting a significant difference was 40%. A sample size of 482 for each group would be necessary to achieve 80% power of detecting a 7% difference, while controlling for 5% type I error. All statistical analyses were performed with SAS version 9.3 (SAS Institute Inc., Cary, NC).

RESULTS

PNP adherence to CCGs was comparable to resident teams for the specific measures used in this evaluation. Based on a hospital-wide goal of ordering diagnostic tests for less than 25% of inpatients with bronchiolitis, there was no significant difference between the PNP team and resident teams. There was no significant difference in the rate of chest x-ray ordering between the PNP team and the resident teams (15% vs 22%, *P* = 0.1079). Similarly, there was no significant difference in viral testing between the PNP and physician teams (24% vs 25%, *P* = 0.9813) (Table 2). Post hoc power analysis indicated that a larger

sample size would be required to increase the power of detecting a statistically significant difference in chest x-ray ordering between these groups. The PNP and resident teams were also compared using compliance with the asthma CCGs, specifically related to the goal of providing an accurate AAP to every patient admitted for asthma. The PNP and resident teams had a similar rate of compliance, with PNPs achieving 81% compliance and MDs 76% (*P* = 0.4351) (Table 2).

LOS and direct costs were compared for the 3 teams for the top 3 APR-DRGs and controlling for acuity. Table 3 illustrates that there were no significant differences in LOS between the PNP and resident teams or between the PNP and PNP/MD teams for these 3 APR-DRGs (*P* < 0.017 considered statistically significant). There was a statistically significant difference in LOS between resident and PNP/MD teams for asthma and pneumonia (*P* < 0.001). The direct cost of care per patient encounter provided by the PNP team was significantly less than the PNP/MD team for all 3 APR-DRGs (*P* < 0.001). The direct cost of care per patient encounter provided by the PNP team was significantly less than the resident teams for asthma (*P* = 0.0021) and pneumonia (*P* = 0.0001), although the difference was not statistically significant for bronchiolitis (*P* = 0.0228) for level of significance *P* < 0.0017 (Table 3).

Figure 1 illustrates the monthly patient census on the PNP and resident teams obtained from daily mid-night census. There was a dramatic seasonal fluctuation in PNP team census, with a low census in July 2009 (22 patients) and high census in February 2010 (355 patients). The resident teams maintained a relatively stable census year round compared to the PNP team.

CONCLUSIONS/DISCUSSION

The results of this program evaluation suggest that the PNP team at CHCO provides inpatient care comparable to the resident teams at a lower cost per patient encounter for uncomplicated bronchiolitis, pneumonia, and asthma. The results of this program evaluation are consistent with previously published studies demonstrating that NPs improve outcomes such as decreased LOS and cost of care.⁹

In the setting of increasingly stringent restrictions in residency work hours, PNP hospitalists are a valuable resource for managing inpatient care. PNPs can provide additional benefits not explored in this program

TABLE 2. Adherence to Bronchiolitis and Asthma Clinical Care Guidelines by PNP and Resident Teams

Clinical Care Guidelines	Diagnostic Test	PNP Team	Resident Teams	<i>P</i> Value
Bronchiolitis care	Chest x-ray	15%	22%	0.1079
Diagnostic testing	Viral test	24%	25%	0.9813
Completed asthma action plans		81%	76%	0.4351

NOTE: *P* < 0.05 considered statistically significant. Abbreviations: PNP, pediatric nurse practitioner.

TABLE 3. Comparison by PNP, PNP/MD, and Resident Teams for Observation and Severity I and Severity II Patients by Direct Cost in Dollars and LOS in hours

	PNP	Resident	PNP/MD	P Value PNP vs Resident	P Value PNP vs PNP/MD	P Value Resident vs PNP/MD
Cost						
Bronchiolitis	\$2190	\$2513	\$3072	0.0228	<0.0001	0.0002
Asthma	\$2089	\$2655	\$3220	0.0021	<0.0001	0.0190
Pneumonia	\$2348	\$3185	\$3185	0.0001	<0.0001	0.1142
LOS, h						
Bronchiolitis	52	52	51	0.9112	0.1600	0.1728
Asthma	36	42	48	0.0158	0.3151	<0.0001
Pneumonia	54	61	68	0.1136	0.1605	<0.0001

NOTE: P < 0.017 is considered statistically significant. Abbreviations: LOS, length of stay; MD, doctor of medicine; PNP, pediatric nurse practitioner.

TABLE 4. LOS Comparison to PHIS for Observation and Severity I and Severity II Patients by APR-DRG and Team

	PNP	Resident	PNP/MD	PHIS Observation	PHIS Severity I-II
LOS, h					
Bronchiolitis	52	52	51	43	70
Asthma	36	42	48	31	48
Pneumonia	54	61	68	46	64

NOTE: Abbreviations: APR-DRG, All Patient Refined Diagnosis-Related Groups; LOS, length of stay; MD, doctor of medicine; PHIS, Pediatric Health Information System, Children's Hospital Association¹³; PNP, pediatric nurse practitioner.

evaluation, such as increased access to care, increased patient and family satisfaction, improved documentation, and improved communication between nurses and physicians.⁶ NP hospitalist providers can also decrease the patient care burden on housestaff, allowing teaching teams to focus on resident education.⁶ This point could be made for the PNP team at CHCO, which contributed to care of inpatients during the peak respiratory season census. This strategy has allowed the resident teaching teams to maintain a more manageable patient census during the winter respiratory season, and presumably has allowed greater focus on resident education year round.¹⁷

Hospitals have been increasingly using evidence based CCGs as a strategy to improve patient outcomes and decrease LOS and cost.¹⁸ CCGs provide an excellent tool for hospitalist physicians and APPs to deliver consistent inpatient care for common diagnoses such as bronchiolitis, asthma, and pneumonia. Increased reliance on CCGs has provided an opportunity to standardize evidence-based practices and has allowed PNPs to expand their inpatient role at

CHCO. The addition of a PNP inpatient team at CHCO also provided an effective strategy for management of seasonal fluctuations in inpatient census, particularly during the winter respiratory season.

Limitations

This is a single-site program evaluation at a free standing children's hospital. Colorado law allows NPs to practice independently and obtain full prescriptive authority, although licensing and certification regulations for APPs vary from state to state. Our results may not be generalizable to other hospitals or to states where regulations differ. Patients admitted to the NOC sites and those assigned to the PNP team at the main campus are generally lower acuity and complexity compared to patients assigned to the resident teams at the main campus. Although we controlled for severity using the APR-DRG severity classification, it is possible that our results were biased due to different patient profiles among the PNP and MD hospitalist teams. There were also potential limitations in the cost analysis, which included nursing in direct costs. Although nurse-to-patient ratios are comparable across hospitalist sites, the ratios may have varied due to fluctuations in patient census at each site. The CCG monitoring measures used in this evaluation also presented limitations. These measures were selected due to the availability of these data in the electronic medical record. Future studies may provide more clinically relevant information by including additional patient outcomes measures specifically related to inpatient medical management.

Despite the limitations in this program evaluation, we feel that these data add to the current knowledge in pediatrics by showing equipoise between these 2

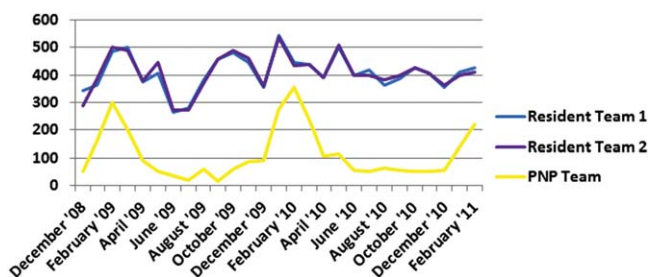


FIG. 1. Pediatric nurse practitioner (PNP) and resident team census by month.

groups. The PNP hospitalist role continues to evolve at CHCO, and the utility of this role must continue to be evaluated and reported.

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