

Impact of an internal medicine nocturnist service on care of patients with cancer at a large Canadian teaching hospital: a quality-improvement study

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Abstract

Background: Nocturnists (overnight hospitalists) are commonly implemented in US teaching hospitals to adhere to per-resident patient caps and improve care but are rare in Canada, where patient caps and duty hours are comparatively flexible. Our objective was to assess the impact of a newly implemented nocturnist program on perceived quality of care, code status documentation and patient outcomes.

Methods: Nocturnists were phased in between June 2018 and December 2019 at Toronto General Hospital, a large academic teaching hospital in Toronto, Ontario. We performed a quality-improvement study comparing rates of code status entry into the electronic health record at admission, in-hospital mortality, the 30-day readmission rate and hospital length of stay for patients with cancer admitted by nocturnists and by residents. Surveys were administered in June 2019 to general internal medicine faculty and residents to assess their perceptions of the impact of the nocturnist program.

Results: From July 2018 to June 2019, 30 nocturnists were on duty for 241/364 nights (66.5%), reducing the mean maximum overnight per-resident patient census from 40 (standard deviation [SD] 4) to 25 (SD 5) ($p < 0.001$). The rate of admission code status entry was 35.3% among patients admitted by residents ($n = 133$) and 54.9% among those admitted by nocturnists ($n = 339$) ($p < 0.001$). The mortality rate was 10.5% among patients admitted by residents and 5.6% among those admitted by nocturnists ($p = 0.06$), the 30-day readmission rate was 8.3% and 5.9%, respectively ($p = 0.4$), and the mean acute length of stay was 7.2 (SD 7.0) days and 6.4 (SD 7.8) days, respectively ($p = 0.3$). Surveys were completed by 15/24 faculty (response rate 62%), who perceived improvements in patient safety, efficiency and trainee education; however, only 30/102 residents (response rate 29.4%) completed the survey.

Interpretation: Although implementation of a nocturnist program did not affect patient outcomes, it reduced residents' overnight patient census, and improved faculty perceptions of quality of care and education, as well as documentation of code status. Our results support nocturnist implementation in Canadian teaching hospitals.

Nocturnists (overnight hospitalists) have been widely implemented in teaching hospitals in the United States in an effort to meet Accreditation Council for Graduate Medical Education workload standards,¹ improve overnight supervision and enhance the quality of patient care.²⁻⁸ Recent data indicate that about 50% of US teaching hospitals have nocturnists.⁹ Several single-centre surveys from the US suggest that nocturnist programs improve perceived quality of care, increase resident satisfaction with overnight supervision and may enhance efficiency.^{3,7} However, studies have not shown reductions in hospital length of stay or rates of mortality or hospital readmission.²

Canadian teaching hospitals have been slow to implement nocturnists.¹⁰ Nocturnal coverage is typically provided by first-year residents from multiple disciplines, with staff available by telephone. Nocturnists are rare, and typically all admissions are performed by residents, without caps on volumes of existing patients or new admissions. Moreover, many Canadian

teaching hospitals rely on teams of residents to cover all admitted medical patients, with no caps on the number of patients per resident. In contrast, in US hospitals, first-year internal medicine residents can manage a maximum of 10 patients.¹

Limits on Canadian resident work hours are determined at the provincial level rather than nationally, as in the US. Only Quebec has stipulated a maximum shift length (16 h), with most provinces still allowing 24-hour shifts. In Europe, resident work hours are restricted to 48-hour work weeks, and 13-hour shift limits are common.¹¹

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Within our own institution, patient volume for internal medicine increased by 68% between 2010 and 2019; this overall growth was driven by a 188% increase in admission volume from our affiliated cancer hospital. In July 2018, we implemented a nocturnist program to address increasing patient volumes.¹² To assess the impact of the program, we used patient-level data to determine its effects on documentation of resuscitation status, mortality, length of stay and readmission. We also surveyed staff and resident physicians to determine their perceptions of the program's impact.

Methods

Design and setting

We performed a quality-improvement study to assess the impact of implementation of the nocturnist program at Toronto General Hospital, a 471-bed urban quaternary teaching hospital in Toronto, Ontario.

Nocturnist service implementation

The Toronto General Hospital has a mean general internal medicine census of 120 patients, mean acute hospital length of stay of 6.1 days and an average of 16 new admissions per day, coming primarily from the emergency department. Patients admitted to general internal medicine are managed by 4 resident teams (called clinical teaching units [CTUs]) and 2 resident-independent units (RIUs). Clinical teaching units consist of an attending physician, 1 second-year or third-year resident, and 3 first-year residents, plus medical students. The average census for our CTUs is 20–25 patients, but it periodically reaches 30–35. Our 2 RIUs are staffed by attending physicians supported by international trainees (fellows), nurse practitioners and physician assistants, and have a cap of 20 patients. One RIU is an oncology team, which manages patients with cancer receiving care at our affiliate, Princess Margaret Cancer Hospital.

Before implementation of the nocturnist service, nocturnal coverage began at 1700 and was provided by 1 first-year resident from each CTU (i.e., 4 on call each night), with supervision by a second-year resident and an off-site attending. Each on-call first-year resident was responsible for covering his or her team's 20–25 existing inpatients and admitting new patients to the team overnight. In addition, 2 of the on-call residents were each required to cross-cover an RIU; this coverage included admitting new patients to the RIU, answering pages, and assessing and managing emergent medical issues for existing RIU inpatients. In aggregate, the 2 cross-covering first-year residents covered 35–45 inpatients and admitted 4–6 new patients per night.

Our nocturnist program was introduced in a graduated manner, with nocturnal coverage increasing over time. Nocturnist shifts were offered to current faculty and independently licensed physicians from the community. Ontario physicians are compensated primarily on a fee-for-service basis by the Ministry of Health, with supplemental payments for off-hours work.¹³ However, competition in the local market necessitated hospital supplementation (about \$1500 per night) to entice

physicians to cover nights. Nocturnist shifts are from 1700 to 0800. Nocturnists are responsible for admissions to the oncology RIU plus overnight coverage of the existing census of both RIUs; they are not expected to supervise trainees.

Participants and outcomes

Survey

Faculty survey participants were general internal medicine physicians (full-time and part-time) who attended on our CTUs in June 2019. This did not include most of the temporary and casual staff who performed the majority of nocturnist shifts during the study period. We also emailed surveys to all residents at the end of their 4-week CTU rotation at our hospital between June and December 2019. Residents at Toronto General Hospital all regularly work in other University of Toronto teaching hospitals, all of which lack nocturnists, which enabled them to assess the addition of a nocturnist program.

Patients

We identified all patients with cancer admitted to the oncology RIU by residents on nights when no nocturnist was on duty and by nocturnists on nights when nocturnists were on duty between July 1, 2018, and June 30, 2019. As nocturnist availability was quasi-random during our ramp-up phase, we expected that patients admitted by residents and nocturnists would generally be similar. There were no exclusion criteria for patients.

For these 2 groups of patients, we compared entry of a code status order in the electronic health record by 0800 on the day of admission, in-hospital death, hospital length of stay and 30-day readmission rate. We selected outcomes commensurate with prior literature evaluating nocturnist programs for which data were available through our hospital's data warehouse.² Preventable readmissions are a target of concern for hospitals and payers; although there are other contributing factors, it is conceivable that some aspect of the initial admission may influence this outcome.

Data sources

Survey

In June 2019, 1 year after implementation of the nocturnist program, we emailed surveys to all physicians who had attended on the general internal medicine CTUs. The survey was developed by 2 of the authors (R.D.-Y. and V.L.-K.). Questions related to perceptions of quality of care, perceived errors and expeditious patient evaluation were adapted from a similar single-centre study of implementation of a nocturnist program,⁷ and those related to burnout and suspected reasons for postintervention improvement were developed by the authors (Appendices 1 and 2, available at www.cmajopen.ca/content/9/2/E667/suppl/DC1). The survey contained additional space for optional free-text responses. The survey was pilot-tested with 2 of the authors (R.C.W. and P.C.), the chief medical resident and 2 other faculty members to ensure

clarity of phrasing and response options; this resulted in only minor modifications. Minimal demographic data were collected to protect confidentiality given the small numbers of participants.

Patients

We obtained patient-level data (e.g., age, sex, admission date, comorbidity) abstracted from our hospital’s electronic health record data warehouse, which complies with Canadian coding standards¹⁴ and can be provided to hospital staff by request. Comorbidity was captured in this database by means of the Charlson Comorbidity Index (score range 0–37; higher scores represent a higher burden of illness).¹⁵ Code status entry was obtained by 1 of the authors (R.D.-Y.) by reviewing the patients’ charts and noting the timestamp in the electronic health record of code status entry; this is our hospital’s contemporary and sole standard for documenting and referring to code status.

Patient census

We used electronic health record data to determine the daily patient census covered by each resident. We used call schedules to combine censuses for residents scheduled to cover their own CTU plus an RIU (i.e., cross-covering). We used a spreadsheet with nocturnist call assignments to determine the number of shifts covered by each physician, and their status as faculty or temporary physicians.

Statistical analysis

We compared demographic characteristics, temporal factors (weekend v. weekday admissions) and comorbidity for patients admitted by nocturnists and residents using bivariate measures. We compared resident census coverage on nights with and without a nocturnist using a *t* test. We examined survey responses using standard descriptive statistics (i.e., mean, median, percentages) in Microsoft Excel. For dichotomous (yes/no) questions, we examined the proportion of respondents who answered “Yes.” For Likert-type questions (scored from 1 [strongly disagree] to 5 [strongly agree] except for the question regarding satisfaction, where 1 = very unsatisfied and 5 = very satisfied), we calculated the mean score for each item. We reviewed free-text survey responses for any concerns that were not included in the survey rather than coding them for formal qualitative review.

We compared unadjusted outcomes for patients admitted on nights with and without nocturnist coverage, and adjusted analyses using logistic regression to control for differences in age, sex and Charlson Comorbidity Index score, as well as weekend admission. We compared the Charlson Comorbidity Index score and acute hospital length of stay for patients admitted by nocturnists and those admitted by residents using *t* tests in SPSS (SPSS Software, IBM Corporation).

Ethics approval

Our survey was considered quality improvement and deemed exempt from ethics review by the University Health Network Research Ethics Board (waiver 19-0338).

Results

Patient outcomes

Nocturnist coverage was present for 241 (66.2%) of 364 nights between July 1, 2018, and June 30, 2019, with 46 nights (19.1%) covered by full-time faculty and 195 nights (80.9%) by temporary staff. Patients admitted by nocturnists (*n* = 339) and those admitted by residents (*n* = 133) were similar with respect to age, sex and Charlson Comorbidity Index score (Table 1). Ninety-four (27.7%) of the nocturnist admissions were performed on weekends, compared to 30 (22.6%) of the resident admissions (*p* = 0.2).

In-hospital mortality was not statistically significantly different for patients admitted by residents (10.5%) as compared to nocturnists (5.6%) (adjusted odds ratio [OR] 1.91, 95% confidence interval [CI] 0.92–4.00). Of the 133 patients admitted by residents, 11 (8.3%) were readmitted to our hospital within 30 days of discharge, compared to 20 (5.9%) of the 339 admitted by nocturnists (adjusted OR 1.35, 95% CI 0.62–2.94). The mean acute length of stay for patients admitted by residents was 7.2 (standard deviation [SD] 7.0) days, compared to 6.4 (SD 7.8) days for those admitted by nocturnists (*p* = 0.3). Entry of code status orders was more common for admissions performed by nocturnists than by residents (186 [54.9%] v. 47 [35.3%], *p* < 0.001).

Patient census

Among the 30 physicians (5 faculty, 25 temporary) who worked on the nocturnist service, the median number of nocturnist shifts performed per physician during the study period was 5.5 (interquartile range [IQR] 2.0–9.8). Among the 123 nights without a nocturnist, the 2 residents required to cross-cover the RIUs had a mean overnight census of 40.0 (SD 3.9) patients, compared to 25.2 (SD 4.7) patients for the 2 residents not required to cross-cover (*p* < 0.001).

Table 1: Characteristics and outcomes of patients admitted to the oncology team by residents versus nocturnists

Characteristic	No. (%) of patients*		<i>p</i> value
	Admitted by residents <i>n</i> = 133	Admitted by nocturnists <i>n</i> = 339	
Age, mean ± SD, yr	61.7 ± 14.5	60.4 ± 14.7	0.4
Female sex	58 (43.6)	159 (46.9)	0.5
Weekend admission	30 (22.6)	94 (27.7)	0.2
Charlson Comorbidity Index score, mean ± SD	4.6 ± 3.0	4.4 ± 3.1	0.6
In-hospital death	14 (10.5)	19 (5.6)	0.06
Readmitted	11 (8.3)	20 (5.9)	0.4
Acute length of stay, mean ± SD, d	7.2 ± 7.0	6.4 ± 7.8	0.3
Documented code status	47 (35.3)	186 (54.9)	< 0.001

Note: SD = standard deviation.
*Except where noted otherwise.

Table 2 (part 1 of 2): Faculty survey responses

Question	No. (%) of respondents* n = 15
Any experience with Toronto General Hospital general internal medicine–oncology Overnight Hospitalist program in clinical experience at Toronto General Hospital	15 (100)
Satisfaction with overall quality of care delivered at Toronto General Hospital, mean Likert score‡ ± SD	3.6 ± 1.7
Since development of the Overnight Hospitalist program, the quality of care delivered at Toronto General Hospital general internal medicine has:	
Improved	11 (73)
Stayed the same	2 (13)
Decreased	2 (13)
The Overnight Hospitalist program has decreased medical errors, mean Likert score‡ ± SD	3.6 ± 1.2
The Overnight Hospitalist program leads to faster overnight evaluation of patients who are already admitted on the wards, mean Likert score‡ ± SD	4.6 ± 0.9
The Overnight Hospitalist program leads to faster evaluation of new patients in the emergency department, mean Likert score‡ ± SD	4.5 ± 0.9
The educational experience on the internal medicine CTU has improved as a result of the Overnight Hospitalist program, mean Likert score‡ ± SD	4.1 ± 1.3
Effect of the Overnight Hospitalist program on your medical billings	
No change	7 (47)
Decrease	2 (13)
Not sure	6 (40)
The Overnight Hospitalist program makes the hospital more attractive to residents, mean Likert score‡ ± SD	4.0 ± 1.7
The Overnight Hospitalist program has reduced trainee burnout, mean Likert score‡ ± SD	4.1 ± 1.0
The Overnight Hospitalist program has reduced faculty/attending physician burnout, mean Likert score‡ ± SD	3.5 ± 1.0
The Overnight Hospitalist program improves my satisfaction while attending at Toronto General Hospital, mean Likert score‡ ± SD	4.1 ± 1.1

Table 2 (part 2 of 2): Faculty survey responses

Question	No. (%) of respondents* n = 15
Benefits of the Overnight Hospitalist program§	
Trainees have no need to obtain handover from or cross-cover teams overnight	12 (80)
Trainees do not need to hand over in the morning to more than 1 team	11 (73)
Trainees do not need to admit to more than 1 team overnight	9 (60)
Trainees have fewer patients to evaluate and admit from the emergency department overnight	12 (80)
Trainees do not need to manage transfers from other hospitals to the ward overnight	6 (40)
Trainees have fewer distractions from their admitting and call duties when working overnight	11 (73)
There is a dedicated physician in house to cover general internal medicine–oncology patients (Team 10)	13 (87)
There is a dedicated physician in house to admit general internal medicine–oncology patients (Team 10)	14 (93)
The physician covering general internal medicine–oncology patients (Team 10) and admitting new patients to Team 10 is more experienced	12 (80)
There is a greater likelihood that the trainee will be able to rest/sleep overnight	4 (27)
There is a greater likelihood that I will be able to rest/sleep overnight	6 (40)
There is a reduced need for trainees to communicate with the attending physician overnight	6 (40)
The nurses have improved access to physicians overnight regarding urgent patient issues	8 (53)
None of the above	1 (7)

Note: CTU = clinical teaching unit, SD = standard deviation.
 *Except where noted otherwise.
 †Rated on a 5-point scale where 1 = very unsatisfied and 5 = very satisfied.
 ‡Rated on a 5-point scale where 1 = strongly disagree and 5 = strongly agree.
 §Respondents could select all that applied.

Survey responses

We received responses from 15 (63%) of 24 faculty, of whom 11 (73%) were full-time faculty members with a median of 9.0 (IQR 3.5–15.0) years in practice. Most respondents (11 [73%]) thought that the nocturnist program had improved the quality of care, 9 (60%) perceived a reduction in medical errors, and 11 (73%) reported an improvement in resident educational experience (Table 2). The perceived benefits of the nocturnist program most commonly selected by the respondents were a reduced need for residents to hand over to

multiple different teams in the morning; a reduced number of admissions per resident; and less cross-coverage of RIU teams, with resultant improvements in care for patients on the RIUs. Most respondents perceived a reduction in burnout among faculty (mean Likert score 3.5 [SD 1.0]) and residents (mean Likert score 4.1 [SD 1.0]).

We received completed surveys from 30 (29.4%) of 102 residents, 25 of whom were in the general internal medicine program. Given the low response rate, these results were considered exploratory. Key findings included a perception of

expedited patient evaluation, reduced medical errors, improved educational experience and reduced burnout. Additional detail is available in Appendix 2, Supplemental Table S1.

Few free-text survey responses were received.

Interpretation

Our nocturnist program reduced the number of patients that residents were managing overnight. Faculty perceived that patient safety (in terms of decreased medical errors) and trainee educational experience were improved. The program was associated with increased documentation of code status but, as expected, had no statistically significant effect on mortality, the readmission rate or length of stay. Our survey respondents reported a reduction in perceived burnout, which may be linked to workload;^{16,17} however, no validated tool was used to assess this objectively. Together, these results suggest that implementation of a nocturnist program can address pressing concerns facing Canadian teaching hospitals.¹⁸

Our finding that our nocturnist program reduced the patient census for trainees, although expected, is important. In addition to trainees' experiencing sleep deprivation and resultant effects on cognitive performance,¹⁹ the complexity of patients' conditions is increasing,²⁰ and both societal and physician norms and expectations are changing with respect to workload and work hours.¹¹ In the United Kingdom, nocturnal reliance on physicians-in-training motivated the Hospital at Night program,²¹ in which specialty-specific nocturnal physician care was replaced by multidisciplinary teams, sometimes led by nurse practitioners. Overnight staffing changes were only part of the model. The Hospital at Night program has resulted in improvements in hospital-wide care, with net cost reduction.²¹

Our study adds to the existing literature regarding the impact of nocturnists on quality of care. A survey by Trowbridge and colleagues⁷ showed that the nocturnist program at an academic medical centre in the US was perceived by both residents and faculty to improve the quality of care. A 2012 survey of US academic hospitalist program directors by Farnan and colleagues⁸ showed that 61% of programs had nocturnists and 24% functioned independently from the teaching teams. Those authors found perceived improvements in patient safety but potential reductions in resident autonomy; a more recent study showed similar findings.⁹ Our survey respondents also felt that the introduction of nocturnists allowed for more rapid evaluation of both new and existing patients.

Our finding that faculty perceived favourable impacts on education and training is somewhat consistent with prior literature.⁷ For example, a survey of residents at a tertiary care academic medical centre in the US showed that nocturnists enhanced trainee perceptions of overnight supervision.⁴ Conversely, Devendra and colleagues²² reported a potential educational cost to nocturnist supervision at an urban US medical centre affiliated with an internal medicine residency program.

Our findings that mortality, hospital length of stay and readmissions were not significantly decreased with the nocturnist program are similar to results of Gonzalo and colleagues.² However, the difference in the mortality rate between patients admitted by residents and those admitted by nocturnists (10.5% v. 5.6%) was quite large clinically. With similar baseline characteristics and postadmission care, it is unclear what may have been responsible for this difference. It is plausible that, given the higher census and longer shifts for Canadian residents than for their US peers, nocturnist programs may confer larger benefits in Canadian hospitals. Further study is warranted to see whether these differences are replicated in other Canadian centres.

Patients admitted by nocturnists were significantly more likely than those admitted by residents to have their code status entered into the electronic health record. Documentation of code status is recognized as an important process measure in hospital medicine and provides tangible evidence of improvements in quality.^{23,24} Although not altogether surprising, this finding reinforces the potential benefits of reducing resident workload and shifting some proportion of new admissions onto experienced hospitalists.

It would be important to formally explore potential drawbacks of nocturnist interventions, including additional handovers, less daytime accountability for overnight issues and lower billings, highlighting the importance of early faculty engagement in similar interventions. Graded responsibility is a hallmark of resident education, and further study is required to determine whether residents perceive the nocturnist as an impediment to the development of clinical independence.

It is also important to recognize the financial support required to implement our program and its potential impact on the "daytime" physician's income. Having an in-house attending physician could reduce the total amount billable to the attending physicians on our RIUs. Incentivizing night work also required a substantial stipend, beyond the fee-for-service income that was generated. Although residents are important care providers, their salaries come from provincial monies rather than hospital budgets. Therefore, employing nocturnists to supplement resident shortages represents a net new cost to Canadian hospitals.

Limitations

The survey response rate from residents was low, and, although the results were mainly congruent with the perceptions of faculty respondents, we consider them exploratory. Our surveys were anonymous, which did not allow identification of nonresponders; together with hospital policies on email volume, this limited our ability to remind nonresponders. Furthermore, multiple residents may have rotated several times through the CTU during the study period and may have been counted in our denominator more than once. The low survey response rate from residents may have introduced nonresponder bias, and social desirability bias may have influenced how respondents answered our survey questions. However, the survey responses were consistent with prior survey-based findings of nocturnist programs

from the US.^{2,7,9} Given the methodologic limitations inherent in self-reported surveys, confirmation of the perceived benefits reported by respondents should be confirmed with objective outcome measures.

Our study was conducted in a single Canadian teaching hospital; as such, our findings must be generalized with care. We did not assess the impact of nocturnists on patient satisfaction or other patient-reported outcomes that might be improved by nocturnists.²⁵

Conclusion

Implementation of the nocturnist program reduced resident workload, and improved faculty perceptions of quality of care, patient safety and educational experiences, as well as documentation of code status. Although there was no statistically significant effect on patient outcomes, our findings, in combination with existing literature, support implementation of nocturnists across Canadian teaching hospitals.

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