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Impact of Resident Duty Hour Limits on Safety in the ICU: A National Survey of Pediatric and Neonatal Intensivists

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Abstract

Objective—Resident duty-hour regulations potentially shift workload from resident to attending physicians. We sought to understand how current or future regulatory changes might impact safety in academic pediatric and neonatal intensive care units (ICUs).

Design—Web-based survey

Setting—US academic pediatric and neonatal ICUs

Subjects—Attending pediatric and neonatal intensivists

Interventions—We evaluated perceptions on four ICU safety-related risk measures potentially affected by current duty-hour regulations: 1) Attending physician and resident fatigue, 2) Attending physician work-load, 3) Errors (self-reported rates by attending physicians or perceived resident error rates), and 4) Safety culture. We also evaluated perceptions of how these risks would change with further duty hour restrictions.

Measurements and Main Results—We administered our survey between February and April 2010 to 688 eligible physicians, of which 360 (52.3%) responded. Most believed that resident error rates were unchanged or worse (91.9%) and safety culture was unchanged or worse (84.4%) with current duty-hour regulations. Of respondents, 61.9% believed their own work-hours

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providing direct patient care increased and 55.8% believed they were more fatigued while providing direct patient care. Most (85.3%) perceived no increase in their own error rates currently, but in the scenario of further reduction in resident duty-hours, over half (53.3%) believed that safety culture would worsen and a significant proportion (40.3%) believed that their own error rates would increase.

Conclusions—Pediatric intensivists do not perceive improved patient safety from current resident duty hour restrictions. Policies to further restrict resident duty hours should consider unintended consequences of worsening certain aspects of ICU safety.

Keywords

Resident duty hours; graduate medical education; Patient Safety; Intensive Care; Pediatrics; Medical Errors

Introduction

New Accreditation Council for Graduate Medical Education (ACGME) recommendations which took effect in July 2011 called for further restrictions on resident-physician duty hours, increased faculty supervision of trainees, better patient handoffs, and an increased focus on systems of patient safety[1]. Duty-hour restrictions are supported by an increased incidence of occupational injuries[2], motor vehicle crashes when driving home[3], poor health effects[4;5], and medical errors by both resident-physicians and nursing staff working shifts greater than 12-16 hours or when sleep deprived[6-8]. In the intensive care unit (ICU), there is an increase in fatigue related medical errors when residents work currently allowed shifts of 24 hours as compared to 16 hours, suggesting that their shifts remain too long[9]. However, studies suggest that the 2003 duty hour limitations have not resulted in decreased resident fatigue while on duty, because the additional time away from work is not used for sleep[10;11]. Five years after duty-hour implementation, studies fail to show safety and quality benefits that were expected as a result of the current duty hour limitations [12-14]. Despite some benefits in resident quality of life, the patient safety impact of ACGME duty-hour limits thus is largely unclear[12;13;15;16].

Resident duty hours have caused a shift of duty hours and workload from resident physicians to attending physicians[17-20]. However, the effects of this shift on errors by attending physicians are not known. Attending physicians are not immune to fatigue related errors when sleep deprived[21]. At particular risk are attending physicians working long shifts in critical care settings, for instance, pediatric intensivists who are increasingly providing 24-hour in-house coverage[22]. In this study, we sought to evaluate perceptions of pediatric intensive care attending physicians on how the current resident duty hour restrictions impact certain pre-defined measures of patient safety risks in the ICU. Because of new duty-hour regulations, we also evaluated perceptions of safety risks with further restrictions in duty hours.

Materials and Methods

We conducted a survey of a national sample of pediatic and neonatal intensivists directly affected by resident duty hour restrictions and defined our study sample as pediatric intensivists who met all of the following criteria:

1. Working in a pediatric intensive care unit (PICU), neonatal intensive care unit (NICU) and pediatric cardiovascular intensive care unit (CVICU), and
2. Involved in training program that included fellows as well as residents. We excluded residency training programs without fellows in order to focus on

attending physicians with heavy exposure to trainees with various levels of experience and responsibility.

We designed a survey instrument to assess perceptions about the current and future impact of resident duty hour restrictions on certain safety-related risk measures in the ICU. Measures included 1) Attending physician and resident fatigue, 2) Attending physician work-load, 3) Errors (self-reported rates by attending physicians or perceived resident error rates), and 4) Safety culture.

Survey Development

The survey was developed by two pediatric intensivists and a psychometrician with guidance from experts in patient safety. We reviewed current literature and previous surveys related to the general topic of physician work-hours and errors[6;9;15;16;19-21;23-25]. We interviewed key personnel, including intensivists from a large tertiary care children's hospital which was later excluded from the study. We developed a 26-item survey using Survey Monkey, a web-based commercial survey tool. Items were presented either as binary responses (yes/no) or as ranking of options on a 5-point Likert-type scale. Additional data collected from each respondent included 1) demographic information; 2) number of years since completing fellowship training; 3) type of practice (CVICU, NICU, PICU); 4) percentage of professional time spent in clinical work; and 5) information on practice characteristics, such as mandatory in-house coverage and use of physician extenders. We also gave respondents the option to write free text answers describing their perspectives on the impact of resident duty hours on overall patient safety, and indicate reasons (if any) for increased medical errors with current duty hour limits. The survey was pilot tested with 11 intensivists for readability, completion time, and face validity and modified based on the testing. Standard definitions of error and safety culture were used from the literature[26;27].

Survey Administration

We first obtained email addresses of program directors of all fellowship programs for NICU, CVICU, and PICU in the United States. We invited each program director to submit a list of all attending physicians providing coverage in their ICUs to participate in the study. Program directors who did not respond to our initial invitation were sent one additional reminder e-mail message. Of 160 programs contacted, we received the requested list from 55; this was defined as our study cohort. Our study cohort had the following regional US distribution: 17(30.9%) Northeast, 21(38.2%) South, 13(23.6%) Midwest, and 4(7.3%) West. Between February and April 2010, prior to new ACGME resident duty hour rules, we sent an e-mail inviting each pediatric intensivist from the 55 programs in our study cohort to complete the online survey. We also sent two subsequent e-mail reminders to improve response rates. The study was approved by the Institutional Review Board of each investigator on our study team.

Data analysis

Data were analyzed using STATA SE/11 software. We report raw numbers and percentages for responses to Likert scale data and for binary responses. Categorical variables were analyzed using the chi-square test. Likert scale responses were evaluated with Mann-Whitney ranksum. Missing responses were included in the denominator for analysis. We compared responses from physicians against several physician characteristics; percent clinical time, mandate for in-house call, use of physician extenders, and years since completing fellowship, and practice setting (unit type). We transformed Likert scale responses into positive or negative binary responses for the purposes of multivariate logistic regression analysis with responses to every question as the outcome variable. In multivariate logistic regression we controlled for attending physician percent clinical time, use of

physician extenders, mandate for in-house call, years since completing fellowship program, and type of unit.

Results

We administered the survey to 688 attending physicians, of which 360 responded (response rate=52.3%). (Table 1) Response rates did not differ significantly between specialties with PICU/CVICU and NICU at 53.0% and 51.9% respectively (p=0.8). Not all respondents answered all survey questions; 12(8.4%) and 19(8.7%) only partially completed surveys in PICU/CVICU and NICU, respectively.

Resident Fatigue and Error

With regard to current duty hour limitations, 218(60.5%) perceived that duty hour limits have reduced resident and fellow fatigue. However, 214(59.4%) of attending physicians believed that duty hour restrictions had no impact on errors and 117(32.5%) of attending physicians believed that duty hours either somewhat or greatly increased the frequency of errors made by residents/fellows in the ICU. Of 347 respondents, the factors perceived to have contributed to an increase in medical errors in ICUs as a result of duty hour limits included: decreased ownership of patients by residents and fellows (89.4%), increased frequency of handoffs (88.3%), decreased critical care knowledge and experience of residents and fellows (85.3%), poor communication in handoffs (76.4%) and resident and fellow fatigue (5%). Respondents could add free text responses for reasons that led to increased medical errors with current duty hour limits. These responses (n=36) were largely categorized along the following four themes: decreased time available for teaching and learning, decreased resident professionalism, decreased continuity of care with a “shift” mentality, and increased resident fatigue due to a shifting work schedule with lack of time to adjust to and from night shift work.

Attending Physician Workload, Fatigue and Error

Nearly all, 328(91.1%) attending physicians had additional allied health providers (nurse practitioners and/or physician assistants) in their ICUs and 162(45.0%) reported having a mandate for in-house overnight call. Overall, 37.5% of respondents reported providing direct patient care after working for more than 16 consecutive hours (clinical and non-clinical) at least once weekly, although the frequency of those reporting these extended shifts varied greatly by specialty; 70.0%, 47.3%, and 29.2% in CVICU, PICU, and NICU, respectively. Ninety-three (25.8%) of respondents reported providing direct patient care for greater than 16 consecutive hours at least once weekly. In univariate analysis, increased frequency of extended shifts was associated with an in-house mandate for overnight call (p=0.02).

When asked about changes in their own practice as a result of the 2003 ACGME duty hour limits, 223(61.9%) believed that they now spent more time providing direct patient care and 201(55.8%) believed they were more fatigued while providing direct patient care. (Table 2) However, 307(85.3%) believed that these changes had no impact on the frequency of medical errors they made while providing direct patient care. Only 47(13.0%) believed that their own error rates were increased either somewhat or greatly due to resident duty hour limits.

Given a scenario of future reduction of resident duty hours, 268(74.4%) of attending physicians believed that further reductions in resident duty hours would increase the number of consecutive hours during which they themselves will provide direct patient care and 277 (76.9%) believed that further reductions would increase their own fatigue during the hours

they provide direct patient care. A substantial proportion (n=147; 40.8%) believed that these reductions would increase the frequency of their own medical errors while providing direct patient care. (Table 2)

To assess the delicate balance between potentially increasing attending physician errors versus reducing resident errors, we asked respondents how likely are errors made by attending physicians to either reach patients or cause them harm as compared with errors made by residents/fellows. Of 354 attending physicians who responded to the question, 193(54.5%) believed that attending errors were more likely to reach a patient while 153(43.2%) believed that attending errors were more likely to cause harm.

Safety Culture

Of respondents, 189(52.5%) perceived that there has been no change in overall patient safety culture as a result of resident duty hour regulations, while 115(31.9%) believed that patient safety culture had worsened. (Table 3) When asked to predict how further reduction in resident duty hours might impact overall patient safety culture in their ICUs, 192(53.3%) felt that patient safety culture would worsen somewhat or greatly, and 145(40.3%) felt that there would be no change in patient safety culture. (Table 3)

Logistic Model

In multivariate logistic regression models, type of unit (CVICU, PICU, NICU), gender, percent clinical time, use of physician extenders, and mandatory in house call did not impact survey responses regarding resident physician errors, self-reported errors, or patient safety culture. Attending physicians who had completed fellowship more than 15 years ago or those currently doing in house call were more likely to report that their current duty hours were either somewhat or greatly increased as a result of duty hour limits, p=0.01 and 0.04, respectively.

Discussion

We conducted a survey of a national sample of pediatric and neonatal intensivists to evaluate perceptions on how the current and future resident duty hour restrictions impact certain pre-defined safety-related risk measures in the ICU. Most intensivists did not believe that the current duty hour restrictions had a positive beneficial effect on errors or safety culture; a majority (91.9%) finding either no change or increased frequency of errors by residents/fellows and another majority (84.4%) finding no change or worse overall safety culture. Most pediatric and neonatal intensivists perceived they worked longer hours, and felt more fatigued when providing direct patient care post duty-hour regulations. Although only few believed this resulted in greater frequency of medical errors in their own practice currently, over 40% of respondents believed that if further reductions in duty hours were to take place, their own medical errors will increase and over half believed that the overall safety culture in the ICU will worsen. Future policies in this area may need to account for downstream effects and unintended consequences for further duty hour restrictions in certain specialties.

Our study strengths include a national sample across multiple pediatric intensive care settings. While several studies have focused on resident physician fatigue and errors, few address attending physician errors, and none previously have evaluated attending physician errors as a result of ACGME resident duty hour limitations in the ICU[6;10;21;28]. We thus inform the growing body of literature regarding the impact of ACGME duty hour limits on the entire healthcare “team”, reinforcing the need to focus on the entire “system” of patient safety, as suggested by the ACGME[1]. Our findings also represent valuable perceptions of

front line educators in the pediatric critical care fields regarding their ability to perform safe care alongside their trainees. This data would almost be impossible to obtain through other methods that have thus far been used to evaluate the duty-hour impact[9;18;28;29].

Fatigued attending physicians might not be able to meet the high educational standards and supervision required in the current training environment[30]. This is highly relevant in critical care where case-based, bedside teaching is the norm[31] and attending physicians increasingly provide 24 hour in-house coverage[22;32]. Furthermore, the workload shift from residents to attending physicians might also shift the fatigue-related errors from residents to attendings correspondingly. Whether this could cause increased harm to patients is unknown. Experience can provide some barrier to errors, as seen in one study where attending surgeons and obstetrician/gynecologists did not have increased complication rates for procedures performed the day after an overnight shift[28]. However, in the subset of attending physicians with sleep opportunities of less than 6 hours, there was an increased rate of complications among post night-time surgical procedures[28].

While the current debate on duty hour regulations continues, our findings suggest that future regulations should pay careful attention to downstream effects and possible unintended consequences. Volpp et.al. recently suggested that rather than a single duty hour structure, the ACGME systematically launch several duty hour plans with prospective evaluation to determine the superior duty hour system[33]. Such comparative effectiveness methodology could include the impact of duty hour limits on the entire healthcare team. Many questions remain regarding the current workforce needed to mitigate the potential consequences related to workload and attending physician fatigue. Additionally, surveys of attending physicians report many negative perceptions of current duty hour restrictions similar to what we report, including decreased continuity of care, reduced time for teaching, reduced resident experience, and increased attending workload[11;18;20]. Attending physician perceptions regarding lack of improvement in resident error rates or patient safety with previous (2003) resident duty hour restrictions are demonstrated in several medical settings[12-14]. Further studies are also needed to better measure error-rates related to increased attending physician fatigue while they take on additional workload in the setting of an unchanged workforce.

Our study had several limitations. We rely only on self-reported data which might not be the best representation of the true state of the problem [34]. For instance, we relied solely on perception of attending physicians regarding their own as well as their resident's fatigue, error rates, and safety culture. These findings may represent dismay over a change in workload and workforce as resident duty hours contract, and prospective investigations are necessary to determine if perceived changes in fatigue, workload, and error rates are supported. However, we previously found pediatrician reported data on medical errors extremely useful to inform the field in certain situations where measurement science is not well developed[23]. Our survey only included pediatric and neonatal intensivists from fellowship programs. The issues of fatigue, prolonged work shifts, and error rates may differ in pediatric residency programs without fellows, as pediatric residents require more supervision and attending presence in the ICU as compared to fellows. We were unable to determine accurately the number of pediatric intensivists currently in practice, and thus unable to define the real denominator we might have been able to reach. Given the voluntary requests for pediatric intensivist email lists, our survey respondents may not be a fully representative sample of pediatric and neonatal intensivists in the US. Although our response rates were modest, they were comparable to physician response rates from other published surveys[18;23;24]. Physician response rates are not only typically lower than in other fields, but have also fallen over time[35;36]. Our results also might not be generalizable to other specialties. We were limited by missing responses to several survey items. In our

analysis we included missing responses in our denominator, biasing our results towards a perception of no impact.

Conclusions

Most attending pediatric intensivists perceive that resident duty hour limits have not improved safety culture or resident error rates in the ICU setting. A significant proportion of them believe that their own error rates will increase with further resident duty hour restrictions, negatively impacting patient safety. Policies to further restrict resident duty-hours should consider unintended consequences of increasing errors by attending physicians.

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Table 1

Characteristics of Survey Respondents*

Characteristic	N (%)
Practice Setting, N=360	
CVICU	51(14.2)†
PICU	128(35.5)
NICU	218(60.5)
Male, N=352	178(50.6)
Years since graduating fellowship, N=357	
0-5 years	122(34.2)
5-10 years	67(18.8)
11-15 years	39(10.9)
>15 years	132(36.7)
Percent time spent on clinical duties, N=352	
0-25%	50(14.2)
26-50%	138(39.2)
51-75%	121(34.4)
>75%	43(12.2)
In-house mandate, N=355	
CVICU, N=14‡	2(14.3)
PICU, N=126	78(61.9)
NICU, N=215	82(38.1)

*Not all respondents answered all survey items. Total number of respondents to return partial or complete surveys was 360.

†Many attendings in the CVICU also covered other units.

‡Attendings who work only in the CVICU and do not cover other units.

Table 2

Respondents perceptions regarding fatigue and medical errors

	Increased greatly N(%)	Increased somewhat N(%)	No change N(%)	Reduced somewhat N(%)	Reduced greatly N(%)
How have the ACGME resident duty hour limits impacted the number of hours per week/shift you spend providing direct patient care? *	63(17.5)	160(44.4)	132(36.7)	0	0
How have the ACGME resident duty hour limits impacted your level of fatigue during hours in which you provide direct patient care? *	54(15.0)	147(40.8)	153(42.5)	1(0.3)	0
How have the ACGME resident duty hour limits impacted the frequency of medical errors you make while providing direct patient care (with or without a resident/fellow)? *	2(0.6)	45(12.5)	301(83.6)	5(1.4)	1(0.3)
How would further reductions in resident/fellow duty hours affect your own frequency of medical errors during the hours you provide direct patient care? *	8(2.2)	139(38.6)	205(56.9)	0	0

* Not all respondents answered every question. Percentages reflect the percent of respondents out of 360 rather than the number responding to individual questions.

Table 3

Responses regarding overall patient safety culture in the ICU.

	Improved greatly N(%)	Improved somewhat N(%)	No change N(%)	Worsened somewhat N(%)	Worsened greatly N(%)
How have the ACGME resident duty hour limits impacted overall patient safety culture in your ICU(s)? *	3(0.8)	48(13.3)	189(52.5)	92(25.5)	23(6.4)
How would further reductions in resident/fellow duty hours impact overall patient safety culture in your ICU(s), compared to safety as it is now? *	1(0.3)	14(3.9)	145(40.3)	157(43.6)	35(9.7)

* Not all respondents answered each question. Percentages reflect the percent of respondents out of 360 rather than the number responding to individual questions.