Intern and Resident Workflow Patterns on Pediatric Inpatient Units: A Multicenter Time-Motion Study

As resident-physician work hours have decreased, and patient complexity and hospital documentation have concurrently increased, concerns have mounted about the time residents have available for education and face-to-face patient care. Single-center internal medicine studies have found that 12% of trainee time is spent with patients vs 40% in front of the computer. To our knowledge, no multicenter studies have evaluated this issue in any specialty, including pediatrics. We sought to quantify the proportion of time spent by residents in direct care, indirect care activities, and education across 9 pediatric institutions.

Methods | We conducted time-motion observations on the pediatric wards of 9 hospitals. Institutional review board approval was granted by the coordinating center (Boston Children’s Hospital; no data were collected at this site) and institutional review board approval was also obtained at all 9 data collection institutions. Activities were categorized using a physician task list previously adapted for pediatric inpatient use. Time-motion observations were scheduled to occur on a representative ratio of hours from all 24 hours of the day, and weekday vs weekend days, divided between interns and supervising residents. During observations, research assistants followed a single intern or resident, recording start and stop times for activities using a time-motion database on a tablet-based Microsoft Access database of 12 major activity categories and 114 minor activities. To compare the percentage of time in activities between groups, we used a generalized estimating equation test, accounting for clustering by observation session with a fixed effect for site, using a Dirichlet distribution (a statistical distribution for a continuous variable—in this case time—across multiple categories—in this case activities).

Results | A total of 3452 hours of time-motion data were collected. Across all sites and levels of training, trainees spent more time in interprofessional communication (34.7%), and at the computer (20.5%), and less time in contact with patients and families (12.0%) and in educational activities (4.7%) (Figure). Residents spent more time than interns in interprofessional communication (38.3% vs 31.1%, \( P = .001 \)) and less time in con-

Figure. Activity Distribution by Category, Interns and Residents Combined (Percentage of Time per 24 Hours)

Major activity categories included subactivities as follows: waiting for something to respond or arrive (computer, paper, patient, telephone), looking for items or people (colleague, consultant, nurse, patient, supplies, telephone, computer, or patient medical record information), paper-write (writing notes on the printed handoff document; handwritten patient notes, orders, or prescriptions), paper-read (reviewing printed handoff document or part of patient record printed on paper, reading reference materials), education (formal education such as grand rounds or didactic lectures, informal medical education such as learning about a disease process during patient rounds, or patient service learning such as learning how to order a test in the electronic medical record, teaching medical students or residents medical information or patient service activities), telephone (answering or reading pager, paging colleague, getting results, scheduling a test/appointment, telephone call with patient/family members, physicians, nurses, medical students, other staff, or personal telephone calls), patient/family contact (taking patient history, casual conversation, physical examination, explaining the plan of care, educating patient, obtaining consent, discussing advance directives, or conducting medical procedures), personal (eating, sleeping, idle, walking, restroom, talking, personal texting/mobile telephone use, in call room, or donning contact precautions), computer-write (typing into the handoff document, email, sending a text page, writing patient notes, discharge summaries, orders, prescriptions, or incident reports), computer-read (reviewing computerized sign-out, patient record, electrocardiograms, chest radiography, or other patient information; reading email, reference articles, or other online reference material), and interprofessional communication (giving or receiving sign-out; listening to patient presentations or communicating with nurses, medical students, physicians, other staff, or multiple people).
tact with patients and families (10.3% vs 13.7%, P < .001). During the night, less time was spent in interprofessional communication (29.5% vs 39.3%, P < .001) and education (1.5% vs 7.6%, P < .001) than during the day, with more time spent in contact with patients and families (13.8% vs 10.2%, P < .001). Less time was spent on the weekends in education (1.4% vs 6.2%, P < .001) and interprofessional communication (29.9% vs 36.7%, P = .007) (Table).

Discussion | In 9 pediatric hospitals, residents spent a large proportion of time in interprofessional communication and at the computer, and relatively little time in direct patient care and education. Trainees working nights and weekends spent more time in direct care and interns spent more time than supervising residents. Time spent in education was particularly low on weekends and nights.

The time pediatric trainees spent at the bedside was similar to that reported in internal medicine studies, but our trainees spent less time at the computer. Education time was less than found by Block et al\(^3\) (where nonbedside rounds was counted as education). We considered nonbedside rounds to be interprofessional communication except during moments when explicit teaching occurred.

Defining time allocation precisely is complex. For example, education and interprofessional communication may occur simultaneously during rounds, but time-motion analysis does not account well for multitasking, a limitation of our study. Additional limitations are the potential for a Hawthorne effect and that observations were restricted to the inpatient setting.

Overall, it is concerning that pediatric residents spend relatively little time at patients’ bedside, despite the centrality of direct patient care to their training, as well as to families’ care experiences. Further, though residency has become more shift-based, education time at night remains disproportionately low. Increasing attention to resident activities throughout the day and night is needed to prioritize direct patient care and education.


table

| Table. Activity Distribution Comparison by Trainee Level and Shift Properties (Percentage of Time per 24 Hours) |
|---|---|---|---|---|---|---|
| | Trainee Level | | Time of Day | | Day of Week | |
| | Hours, % | | Hours, % | | Hours, % | |
| | Intern (n = 1641) | Resident (n = 1636) | P Value | Day Shift\(a\) (n = 1775) | Night\(b\) (n = 1676) | P Value | Weekday\(c\) (n = 2381) | Weekend\(d\) (n = 1056) | P Value |
| | | | | | | | | | | |
| | Interprofessional communication | | | | | | | | | |
| | 31.1 | 38.3 | .001 | 39.3 | 29.5 | < .001 | 36.7 | 29.9 | .007 |
| | Computer time | | | | | | | | | |
| | 21.5 | 19.5 | .33 | 19.3 | 22.0 | .11 | 19.2 | 23.4 | .05 |
| | Patient-family contact | | | | | | | | | |
| | 13.7 | 10.3 | < .001 | 10.2 | 13.8 | < .001 | 11.5 | 13.0 | .25 |
| | Education | | | | | | | | | |
| | 4.8 | 4.7 | .87 | 7.6 | 1.5 | < .001 | 6.2 | 1.4 | < .001 |

\(a\) 5 AM to 4:59 PM.
\(b\) 5 PM to 4:59 AM.
\(c\) Monday 5 AM to Friday 4:59 PM.
\(d\) Friday 5 PM to Monday 4:59 AM.

Author Affiliations: Division of General Pediatrics, Department of Medicine, Boston Children’s Hospital, Harvard Medical School, Boston, Massachusetts (Starmer, Landrigan); Division of Pediatric Hospital Medicine, Department of Pediatrics, Lucile Packard Children’s Hospital Stanford, Stanford University School of Medicine, Stanford, California (Destino); Center for Patient Safety Research, Division of General Medicine, Brigham and Women's Hospital, Boston, Massachusetts (Yoon, Landrigan).

Corresponding Author: Amy J. Starmer, MD, MPH, Division of General Pediatrics, Department of Medicine, Boston Children’s Hospital/Harvard Medical School, 300 Longwood Ave, Boston, MA 02115 (amy.starmer@childrens.harvard.edu).


Conflict of Interest Disclosures: Dr Starmer reported receiving honoraria and travel reimbursement from multiple academic and professional organizations for delivering lectures on handoffs and patient safety. Dr Landrigan has served as a paid consultant to Virgin Pulse to help develop a Sleep and Health Program. He is supported in part by the Children’s Hospital Association for his work as an Executive Council member of the Pediatric Research in Inpatient Settings network. In addition, Dr Landrigan has received monetary awards, honoraria, and travel reimbursement from multiple academic and professional organizations for teaching and consulting on sleep deprivation, physician performance, handoffs, and safety and has served as an expert witness in cases regarding patient safety and sleep deprivation. No other disclosures were reported.

Funding/Support: This study involved the secondary analysis of data collected during the I-PASS (I, Illness severity; P, Patient summary; A, Action items; S, Situation awareness and contingency planning; S, Synthesis by receiver) Study, which was supported by grant R18AE000029 from the US Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation. Additional funding for the I-PASS Study was provided by Oregon Comparative Effectiveness Research K12 Program, grant K12HS019456 from the Agency for Healthcare Research and Quality, Medical Research Foundation of Oregon, Physician Services Incorporated Foundation (of Ontario), and Pfizer (unrestricted medical education grant).

Role of the Funder/Sponsor: The sponsors of the study had no role in the design and conduct of the study; collection, management, analysis and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: The content is solely the responsibility of the authors and does not necessarily represent the official views of the federal government.
COMMENT & RESPONSE

Patent Ductus Arteriosus in Preterm Neonates—Concerns With Some Recommendations

To the Editor

We read with interest the review article by Jain and Shah.

It is a very detailed summary of the current management of patent ductus arteriosus in preterm neonates. However, we are concerned with the apparent recommendation in Figure 1 for the use of diuretics and digoxin. Bhatt and Nahata recommended against the use of digoxin, as its risks seem to outweigh the benefits. Furthermore, Bhatt and Nahata do not include any comments regarding furosemide. In 2008, we published the first Clinical Consensus of the Iberoamerican Society of Neonatology (SIBEN), where 2 recognized experts in the field (Ron Clyman, MD, University of California at San Francisco, and Bart Van Overmeire, MD, Université libre de Bruxelles) and 45 neonatologists from 23 countries were invited for active participation and collaboration. We stated there that “the use of furosemide could increase the prevalence of PDA [patent ductus arteriosus] due to its effects as a prostaglandin inhibitor.”

Furosemide increases prostaglandin production at the renal level. Therefore, the ductus response to the pharmacologic closure treatment with prostaglandin inhibitors (indomethacin and ibuprofen) could be minimized according to randomized studies. Moreover, to our knowledge, there are no studies that report significant benefits of furosemide and none documented long term. Furosemide not only increases the prevalence of ductal patency and can inhibit indomethacin efficacy for closure, but also leads to metabolic, hydroelectrolytic, and renal risks (nephrocalcinosis), as well as hypoaucasia. Therefore, based on the available literature, this consensus group did not recommend the use of diuretics and even less of furosemide at this gestational and postnatal age. In 2014, we repeated these recommendations in our Neofarma SIBEN.

Sergio G. Golombek, MD, MPH
Augusto Sola, MD

Author Affiliations: Division of Newborn Medicine, Department of Pediatrics and Clinical Public Health, New York Medical College, Valhalla (Golombek); Maria Fareri Children’s Hospital at Westchester Medical Center, Valhalla, New York (Golombek); SIBEN (Iberoamerican Society of Neonatology), Dana Point, California (Golombek, Sola).

Corresponding Author: Sergio G. Golombek, MD, MPH, Regional Neonatal Center–Maria Fareri Children’s Hospital, Westchester Medical Center, New York Medical College, 100 Woods Rd, Valhalla, NY 10595 (sergio.golombek@nymc.edu).

Conflict of Interest Disclosures: None reported.


In Reply

We thank Golombek and Sola for their comments on our article. We completely agree with their concern regarding diuretics and particularly increased synthesis of prostaglandin following administration of furosemide (and not prostaglandin inhibition as mentioned in the letter). We would like to inform the readers that Figure 1 of the article was shown to inform readers of all therapeutic modalities used so far in the treatment of patent ductus arteriosus. In the text, it is clearly written “However, 3 RCTs [randomized clinical trials] of furosemide showed no apparent benefit,” and at no point in the article did we assert that diuretics should be used for...