



Who Is Teaching Residents in the Intensive Care Unit? Perceptions of Interprofessional Teaching at an Academic Medical Center

Camille R. Petri^{1,2}, Christine P. Beltran³, Amy M. Sullivan^{1,2}, and Asha Anandaiah¹

¹Division of Pulmonary and Critical Care, Beth Israel Deaconess Medical Center, Boston, Massachusetts; ²Shapiro Institute for Education and Research, Harvard Medical School and Beth Israel Deaconess Medical Center, Boston, Massachusetts; and ³New York University Grossman School of Medicine, New York, New York

ORCID IDs: 0000-0003-4120-3069 (C.R.P.); 0000-0002-2022-7208 (C.P.B.); 0000-0003-1020-3197 (A.M.S.); 0000-0003-1796-1230 (A.A.)

ABSTRACT

Background: Teamwork is essential for high-quality care in the intensive care unit (ICU). Interprofessional education has been widely endorsed as a way of promoting collaborative practice. Interprofessional providers (IPPs), including nurses, pharmacists, and respiratory therapists (RTs), routinely participate in multidisciplinary rounds in the ICU, but their role in teaching residents at academic medical centers has yet to be characterized.

Objective: To characterize perceptions of interprofessional teaching during and outside of rounds in the ICU.

Methods: The authors conducted a cross-sectional survey of critical care physicians, internal medicine residents, nurses, pharmacists, and RTs across three ICUs at a tertiary academic medical center from September 2019 to March 2020. The frequency of different types of rounds contributions was rated on a Likert scale. Means and medians were compared across groups.

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Correspondence and requests for reprints should be addressed to Camille R. Petri, M.D., Division of Pulmonary and Critical Care, Beth Israel Deaconess Medical Center, 330 Brookline Avenue, KS-B23, Boston, MA 02215. E-mail: cpetri@bidmc.harvard.edu.

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Results: A total of 221 of 285 participants completed the survey (78% response rate). All IPPs described that they report data, provide clinical observations, and make recommendations frequently during ICU rounds, but teaching occurred infrequently (mean values, nurses = 2.9; pharmacists = 3.5; RTs = 3.7; 1 = not at all; 5 = always). Nurses were least likely to report teaching ($P = 0.0017$). From residents' and attendings' perspectives, pharmacists taught most frequently (mean values, 3.7 and 3.4, respectively). RTs self-report of teaching was higher than physicians' reports of RT teaching ($P < 0.0001$). Outside of rounds, residents reported a low frequency of teaching by nurses and RTs (means, nurses = 3.1; RTs = 3.1), but they reported a high rate of teaching by pharmacists (mean, 4.4).

Conclusion: Nonphysician IPPs routinely participate in ICU rounds but teach medical trainees infrequently. Physicians' perception of IPP teaching frequency was generally lower than self-reports by IPPs. Exploring modifiers of interprofessional teaching may enhance education and collaboration.

Keywords:

graduate medical education; ICU; interprofessional education

In an age of increasing medical complexity, the importance of teamwork among healthcare providers has been highlighted by the Institute of Medicine, the Agency for Healthcare Research and Quality, and other national groups (1–3). Interprofessional education, where students from different health professions participate in shared learning experiences, has been widely adopted in health professions schools as a way of promoting future collaborative practice (4, 5), but little is known about the interprofessional teaching (IPT) and learning environment for residents in the clinical setting where graduate medical education occurs.

Nowhere is teamwork more important than in the intensive care unit (ICU), where multiprofessional rounds have been associated with improved patient outcomes (6–8). However, beyond their physical presence, little is known about

the current role of interprofessional providers (IPPs), such as nurses, pharmacists, and respiratory therapists (RTs), during ICU rounds (9–11). Furthermore, although the interprofessional environment of the ICU represents an opportunity for IPT and learning, the actual nature of teaching interactions between IPPs and physician trainees in the ICU has not been characterized.

To address this gap, this study was designed to explore the current state of multiprofessional ICU rounds at a large academic medical center, with a focus on the prevalence and nature of IPT interactions between IPPs and physician trainees as perceived by members of the ICU team. Portions of this article were presented as a poster at the American Thoracic Society meeting in 2021, which was held virtually (12).

This article has a data supplement, which is accessible from this issue's table of contents at www.atsjournals.org.

METHODS

Setting, Survey Design, and Distribution

This study was conducted at Beth Israel Deaconess Medical Center in three separate ICUs (two medical, one medical/surgical) that include physician trainees. Multiprofessional rounds are held daily in all units, led by the attending. Nurses and pharmacists are routinely present for rounds on all patients, and RTs join rounds on patients requiring invasive or noninvasive mechanical ventilation or oxygen supplementation via high-flow nasal cannula. Of note, advanced practice providers do not work in the units studied. Eligible study participants included the following ICU team members: all pulmonary and critical care faculty who attend in the ICU, all RTs, ICU nurses working during a 4-week period in September 2019, pharmacists assigned to the ICU during July to September 2019, and residents working in the ICU between October 2019 and March 2020. All data were collected during September 2019 to March 2020.

Because no suitable survey instrument existed, surveys were developed by

authors C.R.P., A.A. (critical care physicians), and A.M.S. (a research psychologist with expertise in survey design and medical education research) on the basis of accepted best practices for survey design (13). We performed an iterative review process and modified the surveys after both cognitive interviewing and pilot testing were performed with representative individuals from the five key stakeholder groups (attendings, residents, nurses, pharmacists, and RTs). Final surveys included five different versions modified for each professional group. Examples are included in the supplementary appendices (*see* Appendices E1 and E2 in the data supplement).

We defined four different types of rounds contributions for survey participants: reporting, observing, recommending, and teaching (Table 1). Surveys asked IPPs about the frequency with which they made these different contributions during rounds, as well as the frequency with which they were invited by any physician on the team to provide additional contributions in each of these categories. Attending and resident surveys asked for

Table 1. Definition and examples of four types of rounds contributions included on survey

Contribution	Definition	Example
Reporting	Providing routine data or information	Reading vital signs
Observing	Highlighting events or data judged to be clinically relevant	Notifying the team that the patient has become hypotensive as propofol has been increased
Recommending	Providing opinion or suggestions about patient care	Suggesting the patient should have a central line placed
Teaching	Providing generalizable knowledge or explaining thinking	Explaining the risks associated with the use of vasopressors in patients without central venous access

perspectives on how often IPPs provided each of the four different types of contributions. Because attendings lead rounds at our institution, attendings were also asked how often they invite contributions from IPPs. Item response scales for frequency were of the Likert type (1 = never and 5 = always). Final surveys also included questions about attitudes toward IPT and teaching practices outside of rounds.

The method of survey distribution prioritized convenience for different professional groups. We gave attendings and nurses the option to complete the survey on a paper form or via an electronic, web-based, secure platform (Qualtrics). We provided medical residents and RTs with paper copies during regularly scheduled meeting times. Pharmacists were invited to participate via the online platform only. The institutional review board of Beth Israel Deaconess Medical Center reviewed the study protocol and determined it did not represent human subjects research.

Data Analysis

All statistical analyses were performed using JMPPro version 16.0 (www.jmp.com; SAS Institute). We report rounds contributions as means, and because of the small sample sizes, we tested with the nonparametric Wilcoxon signed-rank test (a nonparametric alternative for paired *t* tests) for within-group comparisons and the Wilcoxon rank-sum test for across-group comparisons. For tests of associations between continuous variables (such as years of experience) and ordinal Likert-type items (such as reported teaching frequency), we used the nonparametric Spearman's rank-correlation coefficient (Spearman's r). For tests of within-group differences of more than two means (such

as comparing resident reports of average frequency of nurse, RT, and pharmacist teaching), we used Friedman's test. We set an *a priori* level of 0.05 (two-tailed) for all tests of statistical significance. Given the small sample size, statistical tests were exploratory in nature, and subgroup comparisons were not performed.

RESULTS

A total of 221 of 285 participants completed the survey (78% response rate). Survey response rates for the five different provider groups were as follows: nurses 78% (75 of 96), pharmacists 85% (17 of 20), RTs 60% (33 of 55), attendings 88% (23 of 26), and medical residents 88% (73 of 88). Characteristics of the respondents are summarized in Table 2. All surveyed groups reported high levels of collegiality between medical residents and IPPs, with 90% or greater reporting "acceptable" (residents 24%, attendings 21%, nurses 34%, pharmacists 33%, RTs 47%), "mostly strong" (residents 75%, attendings 73%, nurses 56%, pharmacists 60%, RTs 39%), or "ideal" (residents 25%, attendings 3%, nurses 0%, pharmacists 7%, RTs 12%) collegiality between professions.

Nurses on Rounds

Nurses and physicians both indicated that nurses report data, provide observations, and make recommendations at a high frequency (Figure 1). Nurses' self-report of teaching was less than their self-reports of other contributions (Wilcoxon signed-rank test, $|S| < 0.001$ for all comparisons). Estimation of nurse teaching frequency differed between nurses and physicians, with nurses self-reporting teaching "sometimes" (mean, 2.9), whereas residents and attendings perceived nurses teaching less frequently (2.3 and 2.3, respectively; Wilcoxon/Kruskal-Wallis rank-

Table 2. Demographic, experience, and educational background of respondents

Profession	Female Sex, n (%)	Highest Level of Education	Years of Experience in Profession, Median (IQR)	Exposed to IPE in Training, n (%)
Nurses	68 of 74 (92)	Bachelor's or higher: 71 of 75 (95%)	11 (5–22)	16 of 75 (21)
Pharmacists	14 of 16 (88)	Doctorate: 16 of 16 (100%) Residency: 14 of 16 (88%)	4 (3–8.5)	9 of 16 (56)
Respiratory therapists	18 of 32 (56)	Bachelor's or higher: 12 of 33 (36%)	10 (4.5–24)	17 of 33 (52)
Medical residents	31 of 71 (44)		PGY1 26 of 71 (37%) PGY2 30 of 71 (42%) PGY3+ 15 of 71 (21%)	49 of 73 (67)
Attending physicians	8 of 21 (38)		5 (2–11)	8 of 23 (35)

Definition of abbreviations: IQR = interquartile range; IPE = interprofessional education; PGY = post-graduate year.

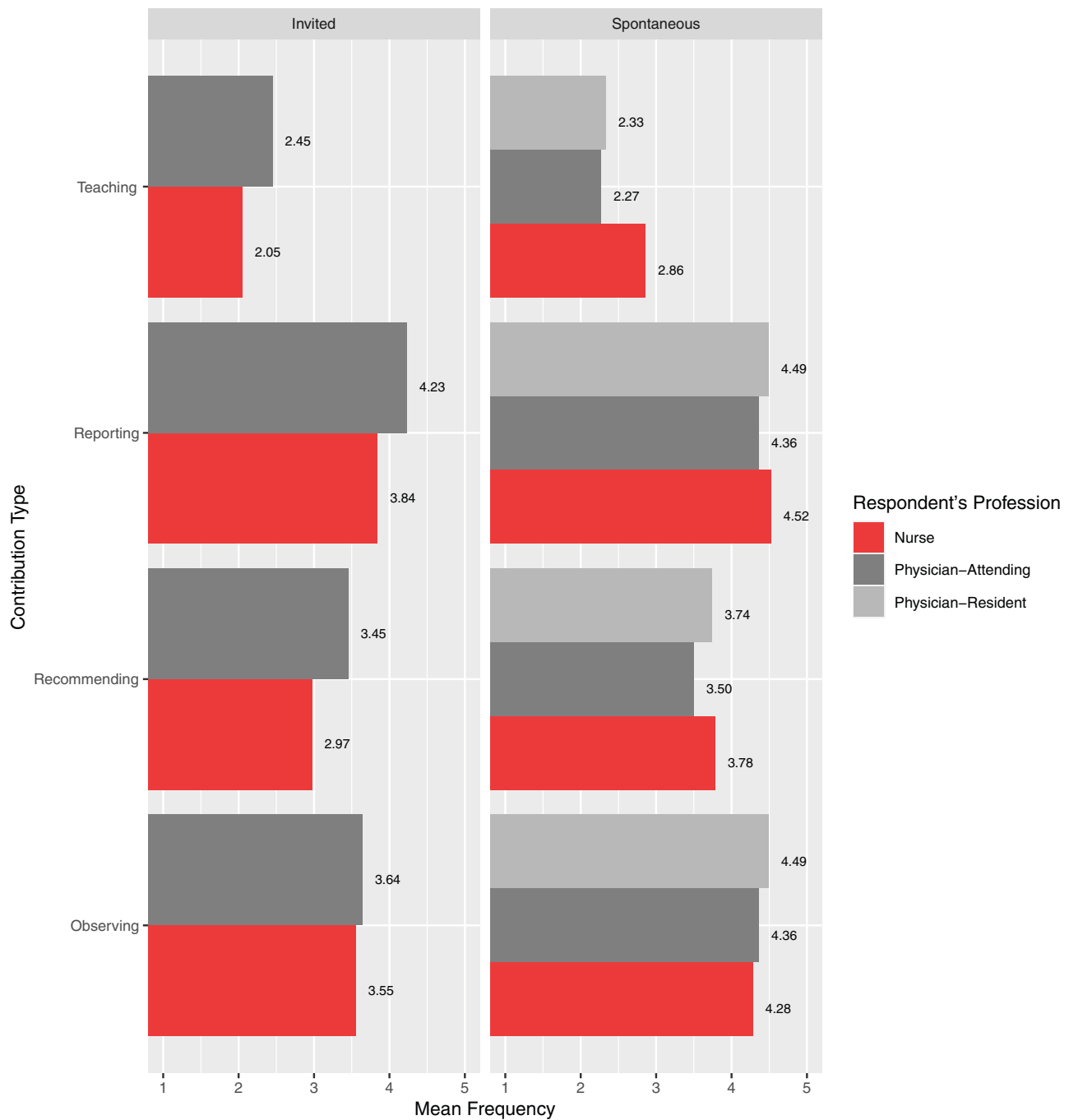


Figure 1. Nurses' self-reports of reporting, observing, recommending, and teaching contributions compared with residents' and attendings' perceptions of the mean frequency of nurses' contributions on rounds.

sum test, 15.4, $df=2$; $P<0.0004$). Attendings reported inviting nurses to make recommendations more often than nurses experienced (3.5 vs. 3.0; $P=0.02$), though the same was not true for attendings inviting nurses' teaching (2.0 vs. 2.5; $P=0.07$).

Pharmacists on Rounds

Both pharmacists and physicians also reported pharmacists' high rates of reporting data, making observations, and providing recommendations on rounds (Figure 2). Similar to nurses, pharmacists

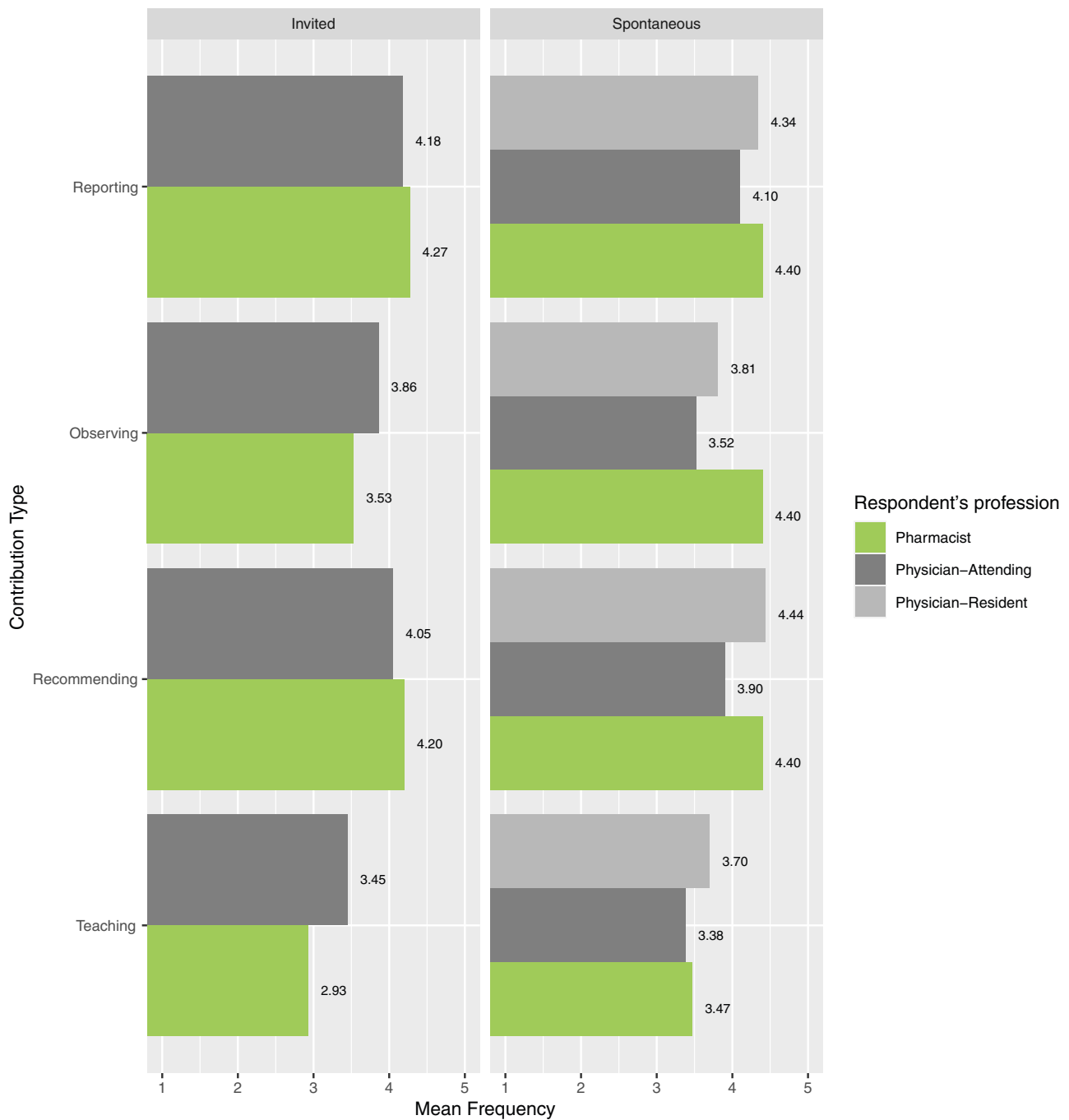


Figure 2. Pharmacists’ self-reports of reporting, observing, recommending, and teaching contributions compared with residents’ and attendings’ perception of the mean frequency of pharmacists’ contributions on rounds.

reported their average frequency of teaching to occur less often than other contributions (Wilcoxon signed-rank test, $|S| < 0.05$ for all comparisons). However, estimated pharmacist teaching frequency

was not significantly different between pharmacists, residents, and attendings (Wilcoxon/Kruskal-Wallis rank-sum test, 2.6; $df = 2$; $P = 0.275$) and was the highest overall frequency across IPPs as ranked by

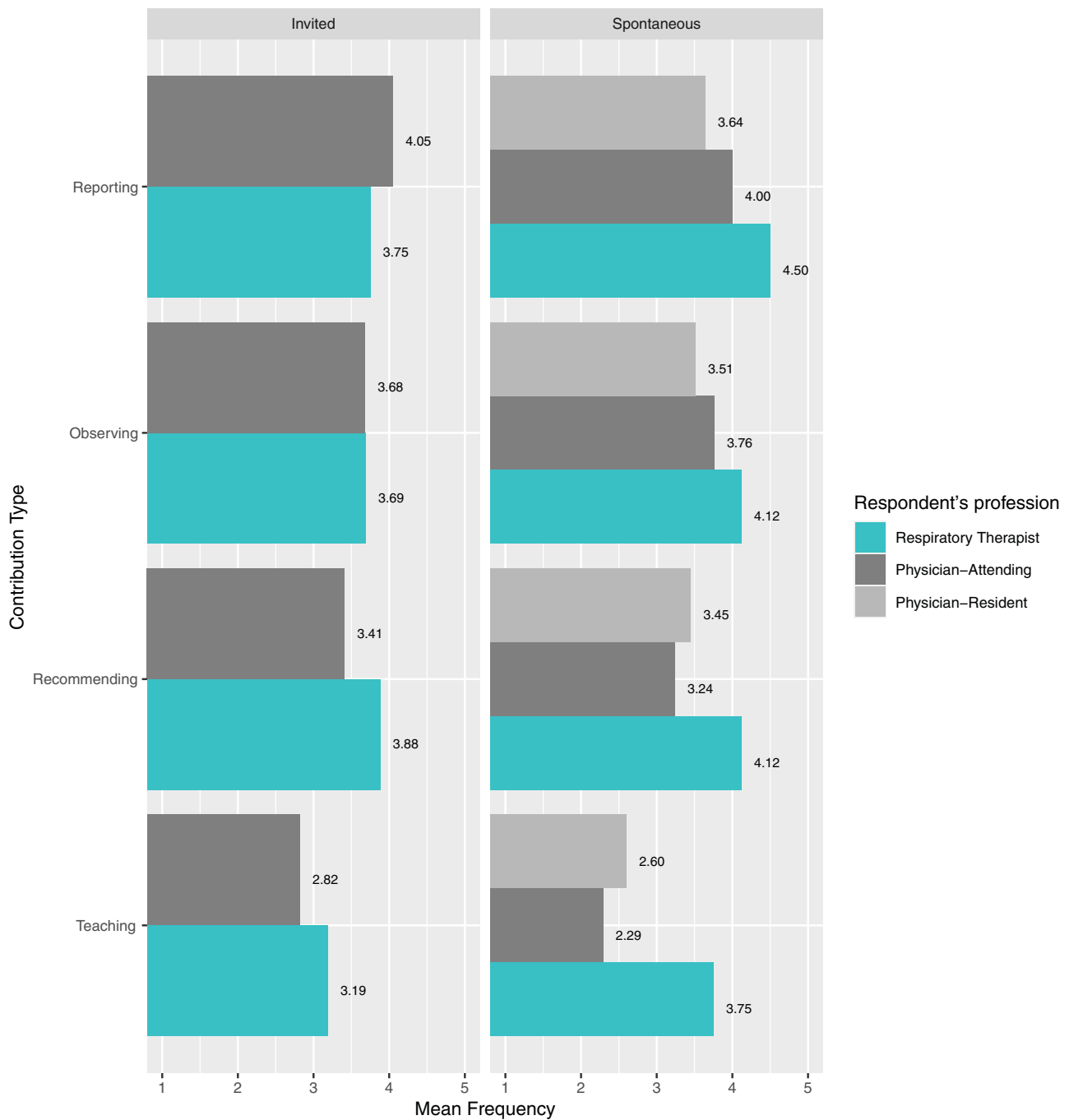


Figure 3. Respiratory therapists’ self-reports of reporting, observing, recommending, and teaching contributions compared with residents’ and attendings’ perception of the mean frequency of respiratory therapists’ contributions on rounds.

physicians. There was no statistically significant difference between pharmacists’ self-report of being invited to teach compared with attending physicians’ reports of inviting them (2.9 vs. 3.5; $P=0.11$).

RTs on Rounds

RTs were more likely to report or provide observations in contrast to teaching (Wilcoxon signed-rank test, $|S|=0.016, 0.031$, respectively), though

there was no difference between mean frequency of recommending and teaching (Wilcoxon signed-rank test, $|S| = 0.070$). However, RTs reported a higher frequency for all contribution types than what was perceived by residents and attendings (Figure 3). This difference was most pronounced in the categories of recommending and teaching. RT self-report of teaching was higher than attending and resident report of teaching by RTs (Wilcoxon/Kruskal-Wallis rank-sum test, 22.5; $df = 2$; $P < 0.0001$).

Comparison across Different Interprofessional Groups

Nurses were less likely than their IPP colleagues to report teaching (mean, 2.9; Wilcoxon/Kruskal-Wallis rank-sum test, chi-square = 12.7; $df = 2$; $P = 0.0017$). Self-reported frequency of teaching was similar between RTs (3.7) and pharmacists (3.5). There was no statistically significant correlation between experience and self-reported teaching frequency for nurses or pharmacists. Data from RTs did show a moderate correlation (Spearman's $r = 0.66$; $P = 0.007$).

Across IPPs, attending ICU physicians reported inviting pharmacists to teach most frequently (3.5), compared with RTs (2.8) and nurses (2.5). Furthermore, across IPPs, nurses' report of being invited to teach was the least frequent surveyed action (2.0). Attendings' years of experience was associated with the frequency of inviting an RT to teach (Spearman's $r = 0.65$; $P = 0.016$), but not for nurses or pharmacists.

When comparing mean teaching frequency from the learner's perspective, residents reported that pharmacists taught most frequently (3.7; standard deviation [SD], 0.8), followed by RTs (2.6; SD, 0.9)

and nurses (2.3; SD, 0.8; Friedman's test, $P < 0.001$; Wilcoxon signed-rank test, $P < 0.001$ for all comparisons), with a large effect size ($W = 0.72$). Among attendings, reports of teaching frequency across these different professions also indicated that, on average, attendings perceived pharmacists as teaching most frequently (3.4; SD, 0.7) compared with RTs (2.3; SD, 0.8) and nurses (2.2; SD, 0.9) (Friedman's test, $P < 0.001$; $W = 0.63$). There was no statistically significant difference between attending-reported nurse and RT mean teaching frequency (Wilcoxon signed-rank test, $P = 0.53$ for comparison).

IPT Outside of Rounds

Our surveys also asked respondents about the nature of IPT interactions occurring outside of rounds. In general, residents reported a low frequency of teaching by nurses and RTs outside of rounds (nurses, 3.1; RTs, 3.1). When it did occur, teaching by nurses and RTs most often took place at the bedside (49% for nurses, 64% for RTs). In contrast, residents reported a high rate of teaching by pharmacists outside of rounds (mean, 4.4) most often occurring at the desk (54%) or over the phone (30%). Although all providers reported teaching during daytime working hours, residents indicated that a significant proportion of teaching by nurses (38%) and RTs (55%) occurred at night.

DISCUSSION

In this survey study of nurses, pharmacists, RTs, and physicians, we found high rates of participation in rounds among all IPP groups but lower rates of teaching compared with reporting, observing, or recommending. Our results further show distinct profiles of IPT for different IPP groups. In both self-report

and reports by attendings and residents, nurses teach infrequently overall, both within and outside of rounds, and with a greater proportion of teaching occurring at the bedside and during the night. Residents and attendings perceived pharmacists, compared with other IPP groups, to teach most frequently, but pharmacists still reported relatively infrequent invitations from attendings to teach on rounds. Pharmacists did, however, report providing substantial resident teaching outside of rounds both at the resident's desk and over the phone. Finally, RTs reported a greater teaching frequency than that perceived by residents or attendings, with the largest out-of-rounds portion of their teaching occurring at the bedside and at night.

The relatively low rates of reported IPT are likely attributable to historical and pervasive silos in health professions education (14, 15). However, the differences among IPP groups are noteworthy and may have several possible explanations. Low rates of teaching by nurses may relate to conventional hierarchy and the distinct domains of expertise held by nurses. Relatively higher rates of teaching by nurses at the bedside and at night suggest that residents capitalize on this important expertise in more informal settings and when immersed in bedside clinical care of patients.

High rates of teaching by pharmacists may stem from similarities in educational backgrounds between pharmacists and medical trainees and the direct relevance of pharmacists' expertise to resident work (i.e., entering orders for medications). The notable discrepancy between self-reported rates of teaching by RTs and that perceived by physicians is not well explained but may relate to lack of clarity on the

definition of teaching. Furthermore, at our institution, RTs are not dedicated solely to the ICU and thus may have difficulty separating their ICU experiences from other assignments.

This is the first study to examine the roles of IPPs on multiprofessional rounds in detail through query of all participants. Although prior studies have outlined significant positive impacts of multiprofessional rounds, including an association with decreased ICU mortality (6) and fewer adverse drug events (16), the mechanisms behind this potential effect have not been fully investigated. This study sheds light on this question by providing a window into the interprofessional interactions that compose multiprofessional rounds. Furthermore, the nature of educational interactions between IPPs and medical trainees on multiprofessional rounds in an academic medical center has not been described previously.

In addition to quantifying teaching interactions, our study results reveal opportunities to promote IPT, a potentially powerful way to flatten hierarchy, dismantle silos, and ultimately promote collaborative care (17). Specifically, it is notable that all IPP groups reported providing recommendations more frequently than teaching, with the largest gap between these contributions reported by nurses. The act of providing a recommendation implies that IPPs believe they have knowledge or expertise relevant to clinical decision making. Exploring ways to transform recommendations into teaching represents a potentially feasible method of promoting IPT. Importantly, study results suggest that the attending physician has a key role to play in modulating these interactions because attendings reported

current relatively low rates of inviting IPPs to teach during rounds. Finally, the finding that nurse and RT teaching outside of rounds occurs primarily at the bedside correlates with their domains of expertise and suggests that increasing residents' presence at the bedside may also create opportunities for IPT.

Limitations

This study has several limitations, most notably its single-center setting. Interprofessional relationships may vary substantially on the basis of the culture of any given institution, and it is possible that our results may not be generalizable to other academic medical centers. However, high levels of self-reported collegiality between professions in our study suggest that IPT is limited even in the setting of positive interprofessional relationships. Furthermore, our study did not include direct observations. Self-reported behaviors may be subject to recall bias, although our design attempted to ameliorate this by surveying only practitioners recently embedded in the ICU. Social desirability bias may have inflated the reported frequency of interprofessional interactions. It is also possible that the microculture created by individual attendings influences the types of frequencies of contributions from IPPs. Our study attempted to avoid this by surveying groups over a long period of time and across multiple ICUs. Furthermore,

survey questions were restricted to descriptions of current practice and do not provide insight into the thoughts, attitudes, or perceptions that are behind the described behaviors. Finally, our survey's focus on rounds, as the *de facto* opportunity for teaching and learning by virtue of all team members being present, may not have captured all influential teaching opportunities occurring in the ICU.

Conclusions

This study provides important insights into the nature of interactions between IPPs and medical trainees in the ICU, a clinical setting where multiprofessional teamwork is critical to optimal patient care. Although the results confirm that IPPs provide many contributions to ICU rounds, variable rates of teaching suggest that there are opportunities to promote IPT as a mechanism for further developing interprofessional teamwork and collaborative care. The potential role of the attending to foster teaching of residents by IPPs is also a promising direction for future intervention studies. Further multicenter studies including direct observations of rounds and exploration of barriers and facilitators to IPT should be conducted.

Author disclosures are available with the text of this article at www.atsjournals.org.

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