

Resident Sign-Out: A Precarious Exchange of Critical Information in a Fast-Paced World

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Abstract

Background: Sign-out is a mechanism of transferring information, responsibility, and authority from one set of caregivers to another. In teaching hospitals, sign-out between resident physicians has a long tradition. Because of the need to reduce the number of hours residents spend in the hospital, the number of sign-outs has increased, while continuity of care during hospital stays has decreased. As a result, when caring for hospitalized patients, residents have become increasingly dependent upon exchange of information during sign-out. Despite its critical importance, little research has examined the content, process, and effectiveness of resident sign-out. Even less is known about how sign-out should be conducted or how interventions might improve the quality of sign-out. **Methods:** Between October 2005 and February 2006, and again between October 2006 and February 2007, residents completed a post-call survey immediately after a call shift; we also audio-recorded sign-out sessions. **Results:** At baseline, an unexpected event arose during one-third of call shifts that should have been anticipated and discussed during sign-out. Recordings demonstrated sign-out was informal and unstructured with very wide variation in the type and extent of information exchanged. Based on these results, we explicitly defined the goals of sign-out; characterized information needed for concise, complete, and consistent sign-out; outlined a structured process to enhance the quality and efficiency of information exchange; developed a computerized tool to facilitate the process; and developed a curriculum to train residents how to sign-out more effectively. After implementing the new process and computer tool, the percentage of call nights when an unexpected event arose that should have been anticipated and discussed during sign-out was nearly identical to that at baseline. **Conclusion:** Although resident physicians frequently sign-out to one another, there are many times when important information is not transmitted. Future studies should be directed at identifying the information physicians need while on-call and clearly describing the goals and characteristics of a concise and complete sign-out. Additional studies are also needed to identify how to best teach and evaluate a physician's ability to sign-out and how technology can be employed most effectively and appropriately.

Introduction

Sign-out is a mechanism of transferring information, responsibility, and authority from one set of caregivers to another set of caregivers.^{1, 2, 3, 4} The primary objective of sign-out is the accurate transfer of information about a patient's state and plan of care from one set of health care providers to another.⁵ At the conclusion of an effective sign-out, caregivers should have a clear mental picture of the patients for whom they are assuming care, know the current status and plan of care for those patients, and have a sense of what problems and issues may arise during the next shift.

Effective and accurate sign-out is important for patient safety and successful patient care.⁶ Incomplete information transfer and incomplete and/or unclear communication of the plan of care to covering physicians can adversely affect the quality of care.^{6, 7, 8, 9} The risks of failing to be told, forgetting, or misunderstanding information that has been communicated during any patient care hand-off can be substantial.^{7, 8, 9, 10} Communication problems are the most common cause of in-hospital disability and death.¹¹

More than 60 percent of root causes of sentinel events reported to the Joint Commission are due to failures of communication between health care personnel.¹² Resident physicians believe communication difficulties play a major role in the vast majority of medical mishaps they experience.¹³ The discontinuity of care that results from frequent sign-outs and handoffs is associated with longer hospital stays, an increase in the number of laboratory tests ordered and performed, and an increase in the number of self-reported preventable adverse events.^{4, 6, 14}

In teaching hospitals, sign-out between resident physicians has a long tradition. In July 2003, duty-hour restrictions were instituted for all residency programs in the United States. Residents are limited to 30 continuous hours and 80 total hours per week in the hospital, accompanied by 10-hour rest periods away from patient care. Because of the need to reduce the number of hours resident physicians spend in the hospital, the number of sign-outs between resident physicians has increased, while physician continuity of care during hospital stays has decreased.^{15, 16, 17} As a result, when they are caring for hospitalized patients, resident physicians have become increasingly dependent upon the exchange of information during sign-out.^{1, 10, 18}

Despite its critical importance, little research has examined the content, process, and effectiveness of resident sign-out, and even less is known about how sign-out should be conducted or how interventions might improve the quality of sign-out.^{1, 3}

With the set of studies discussed herein, we characterized and ascertained the effectiveness of the sign-out process on two acute care wards at the University of Virginia Children's Hospital. After reviewing these findings, as well as the available literature, house staff, faculty physicians, and systems engineers explicitly defined sign-out, identified the content of an ideal sign-out, delineated an ideal sign-out process, and developed specifications for a computerized tool to facilitate the new sign-out process.

This idealized sign-out process and the new computer-based tool were implemented, and the impact of these changes were then assessed. Our primary outcome measure was the number of call nights when something unanticipated occurred that the residents judged could have been anticipated and should have been discussed during sign-out.

Methods

Scope and Study Population

The Institutional Review Board of the University of Virginia approved this study, and all participants gave informed consent. The study was conducted on two contiguous general pediatric wards at the University of Virginia Children's Hospital. The general pediatrics service

comprises three first-year pediatric and/or family medicine residents, two third-year pediatric residents, and a pediatric attending physician. Each patient is assigned to a first-year and a third-year resident. The first-year resident serves as the child’s primary care provider, and the third-year resident functions as a supervisor.

The entire team rounds together every morning. Night coverage is shared by eight residents—the three first-year residents, two third-year residents on the general pediatric ward rotation, two second year pediatric residents, and one first-year pediatric resident—who are on other rotations and “cross-cover” at night. Residents are on call every fourth night. During each night shift, one first-year resident and one second- or third-year resident are on call and care for all of the patients on the two units. The organizational structure of the ward team is depicted in Figure 1.

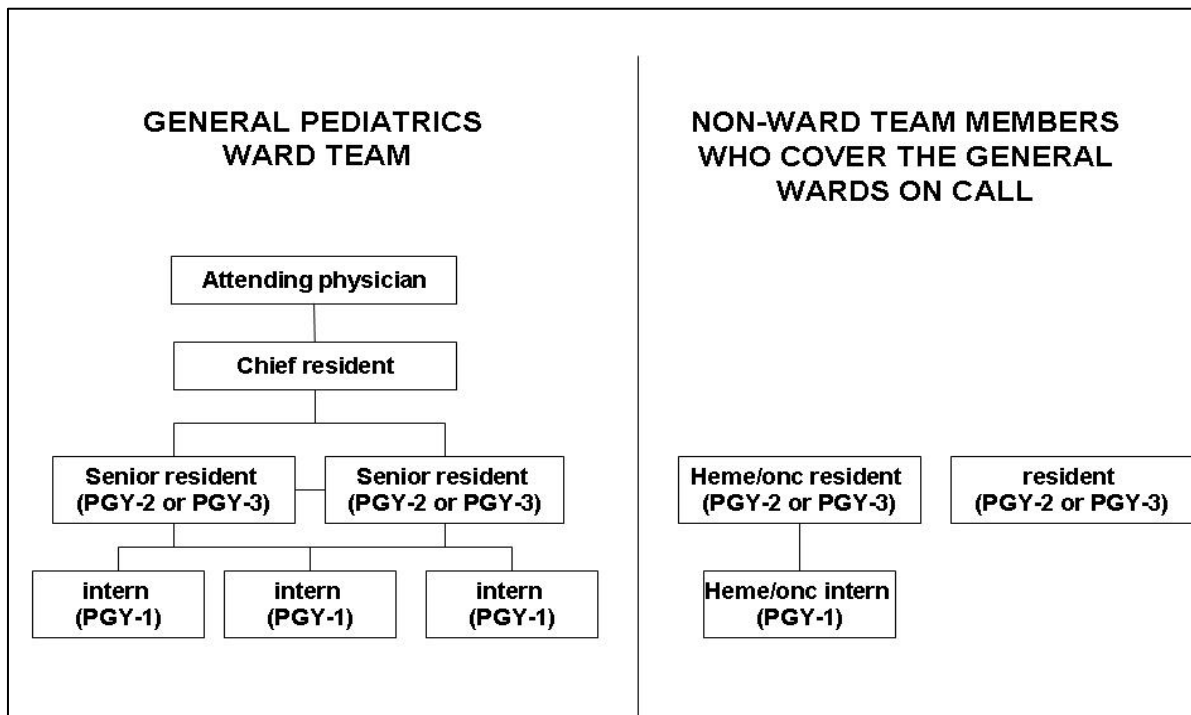


Figure 1. The organizational structure of the ward teams

Sign-out for these wards takes place in the pediatric library, which is located on one of the units. On weekdays, at 7:00 am, residents who had been caring for all of the patients on the wards during the night shift meet with other members of the team to review what happened overnight and to hand-off care back to the primary team. At 4:00 pm, team members meet with the two residents who will be on-call that night and who will care for the patients overnight. This is the longest, most comprehensive, and perhaps the most important sign-out session because members of the general ward team are handing off care of all the patients on the wards to two physicians who might or might not be members of the primary team.

On weekends, there is a single sign-out at noon each day, at which time the pair of residents who have cared for the patients over the previous 24 hours and are ending their shift hand-off care to a pair of residents who will assume care of the patients for the following 24 hours. During this study, we focused on the 4:00 pm weekday sign-out and weekend sign-outs because these often

involved physicians unfamiliar with the patients and were typically the most comprehensive sign-outs. The residents identified the 4:00 pm sign-out as the most important daily sign-out session.

Assessment of the Effectiveness of Sign-Out by Post-Call Surveys

Over 98 days, spanning a 4-month period during the winter of 2005-2006 (baseline), and during the same 4 months during the winter of 2006-2007 (post-intervention), after night post-call residents were on call on the two pediatric acute care wards, they received a text page reminding them to complete a confidential printed two-page survey (Appendix 1).

The survey characterized their night on call. They were asked to assess the adequacy of the sign-out they had received; whether any unexpected/unanticipated problems had arisen while they were on call; whether those problems could have and should have been anticipated and discussed during sign-out; and finally, where they went to get information they did not receive during sign-out.

The survey was created by the authors based upon a conceptual model of hand-offs of care developed through an institutional quality improvement project and preliminary data obtained by a systems engineer who attended and recorded 15 sign-out sessions. Concurrent with the audio-taped sign-outs, the engineer followed first-year physicians through their call period to ascertain what types of questions the residents were asked while on call and how they tried to answer those questions. There were repeated measures on individual nights of call and by individual residents on different call nights.

Our principal means of data collection was through post-call surveys, during which we asked resident physicians whether problems could have and should have been anticipated and discussed during sign-out. These types of assessments can introduce significant hindsight bias.

Baseline Characterization of Sign-out Sessions

Sign-out sessions were audio-recorded using two microphones placed at either end of the conference table where sign-out took place. In addition, an analyst silently observed the sign-out session and entered data about each sign-out using a software tool developed for this purpose.¹⁹ The tool supported real-time characterization of the type of patient information conveyed, in addition to recording the time and duration of patient discussions, events, and interruptions (such as pages and telephone calls). The tool also provided the ability to modify entered data and to review data at later times. All characterizations made using the software tool were stored in a Microsoft Access database for subsequent analysis.

Characterization of an Ideal Sign-Out

Results of a literature review, the sign-out survey described above, and the direct observation of sign-out described above were shared with the entire pediatric house staff and selected faculty physicians. There was a clear consensus that sign-out was a point of vulnerability and that opportunities to improve it were substantial. During two 1-hour facilitated sessions, the pediatric house staff, faculty physicians, and systems engineers explicitly defined the goals of sign-out and identified barriers and opportunities for improving ward sign-out.

During eight 1-hour facilitated sessions, a smaller working group of house staff, faculty, and systems engineers:

- Explicitly defined the purpose and goals of sign-out.
- Identified and characterized the information needed for a concise, complete, and consistent sign-out.
- Characterized a structured sign-out process meant to enhance the quality and efficiency of information exchange (including the logistics of who, what, where, and how).
- Developed specifications for a computerized tool to facilitate a new sign-out process.
- Developed a curriculum to train house staff on how to sign-out more effectively.
- Developed a process to evaluate a house officer's ability to sign-out effectively and provide them with constructive feedback.

The recommendations of this working group were brought to the entire house staff for approval, after which an implementation plan was developed.

Implementation of a New Sign-Out Process and Computerized Sign-Out Tool

During late June and early July 2006, we conducted two 1-hour teaching sessions about ward sign-out with the entire pediatric house staff. During the first session, we briefly reviewed the existing literature and shared our baseline data with them. We characterized the process we had gone through to define an ideal sign-out. We then shared the definition, goals, and characteristics of an effective and efficient sign-out and clearly outlined what information should and should not be included. Finally, we explicitly characterized a new and more structured sign-out process.

During the second teaching session, we conducted individual and group role-play exercises, during which we performed and critiqued simulated sign-outs. The information requirements for effective sign-out were operationalized in a prototype database application to support the sign-out process. During a 5-month period, resident physicians used the application and provided additional data entry and reporting requirements, which were iteratively incorporated into the application.

Residents initially characterized 6 general and 27 specific information requirements for the tool. Both data entry and reporting requirements were refined, and the application was modified as residents used the system. With respect to data entry, residents identified specific needs for adding, deleting, or modifying individual patient records, as well as sorting patients by acuity, service, and location.

With respect to reporting, customized reports were requested based upon time of day, acuity of patients, clinical service, or location. The report format was modified to maximize the amount of information on each page, while enhancing readability and highlighting critical data elements. By the end of the trial period, residents reported significant improvement in the efficiency of their sign-out process, and the database had become an integral part of their workflow.

Results

Data Analysis

Continuous variables were compared using unpaired two-tailed t-tests. Dichotomous variables were compared using Fisher's exact test. Differences were considered statistically different if the *P* value was <0.05. Unless otherwise stated, all results are presented as mean \pm standard deviation.

Characterization of Baseline Sign-Out Sessions

Between July 2005 and February 2006, 15 different sign-outs, involving 209 patients, were observed and recorded. Sign-out sessions lasted 34.3 ± 15.5 minutes, with a range of 11.1 to 70.3 minutes, during which time resident physicians discussed 14.0 ± 3.6 patients, with a range of 8 to 20 patients. These 15 sign-out sessions were interrupted a total of 60 times. Pagers went off an average of 3.06 ± 2.12 times per sign-out (range, 0 - 7). Direct interruptions by members of the hospital staff, who were not involved in sign-out (e.g., nurses and physicians from other services), were common (0.87 ± 0.99 per sign-out session [range, 0 - 3]). Of the 15 sign-out sessions, 4 were interrupted by telephone calls. Significant background noise, such as from other conversations, was common during the recorded sign-out sessions, occurring 2.7 percent of the time (± 11.3 percent, range, 0 - 37.8 percent).

Matters not directly related to patient care ("off-task") accounted for 23.2 percent of sign-out session time. Of the time spent "on-task," 87.2 percent was spent on one-way information transfer from the resident going off call to the resident coming on call. Background information prior to the current hospitalization accounted for 32.2 percent of the information transferred. A mean of 12.1 percent of the time was spent discussing what actions, both planned and contingency, should occur overnight. Of the nine categories of patient information, no single category of information was discussed for every patient. Residents described the patient's current condition for 35.4 percent of patients, reviewed current medications for 62.7 percent of patients, and outlined contingency plans for possible scenarios for 17.7 percent of patients.

Characterization of an Ideal Sign-Out

Based on the process described above, ward sign-out was defined as a concise, face-to-face, written and verbal communication of pertinent patient information that was necessary for optimal patient care until the next shift. Sign-out should focus on identifying anticipated problems and the appropriate plan of care for each, and it should provide a process check of actions completed and those needed before the next hand-off of care, as well as an opportunity to ask questions and obtain clarification. In summary, recommendations for the ideal sign-out included the following:

- Sign-out should take place face-to-face to facilitate questioning, clarification, and collaborative cross-checking.
- Start/finish times should be defined
- Sign-out should take place in a quiet/secure location, such as a small private conference room, rather than the pediatric library to minimize interruptions/distractions.
- The roles and responsibilities of all participants should be clear.

- The focus should be on patient safety and effective communication, with an emphasis on abstraction, synthesis, and summation of information.
- The sickest patients should be discussed first, and information should be discussed in a consistent order.
- Ward sign-out should start at 4:00 pm. and last no longer than 30 minutes.
- All participants should be physically present the entire time.
- Uncompleted tasks should be completed after sign-out has been finished.
- Nursing staff and faculty should be instructed to not page ward house staff between 4:00 and 4:30 pm, except for emergencies.
- In general, interns should “give” sign-out with senior residents listening and/or clarifying.
- Medical students should attend but should primarily listen.
- Off-task activities, such as writing notes and putting in orders, should be minimized to promote efficiency, and only the essential information should be exchanged verbally. Other information can be written on the sign-out sheet and/or found elsewhere.
- Selected demographics, problems, medications, and treatments should be characterized.
- Only those things that are crucial to the child’s care should be discussed (e.g., if managing dehydration, the most recent set of electrolytes could be mentioned). Additional information can be included on the written sheet.
- It should not be necessary to replicate large amounts of information either verbally or on paper that are already in the patient’s medical record.
- Every sign-out should include a specific to-do list and contingency plans.
- The focus should be on trying to anticipate issues that might arise over the next shift, and what actions might be taken.

Assessment of the Effectiveness of Sign-Out Through Post-Call Surveys

During the baseline assessment, 158 of a total potential 196 surveys (81 percent) were completed, whereas during the post-intervention assessment, 168 of a potential 196 surveys (86 percent) were completed ($P = 0.71$). At baseline, 60 percent of the surveys were completed by members of the general pediatric ward team, and 40 percent were completed by residents who were “cross-covering” on the wards at night or during a weekend. By contrast, during the post-intervention assessment, 59 percent of the surveys were completed by members of the general pediatric ward team, and 41 percent of the surveys were completed by residents who were “cross-covering” on the wards at night or during a weekend ($P = 0.99$). For both time periods, this is very similar to the percentage of night calls covered by residents on the general ward team (62 percent) and residents who were cross-covering (38 percent).

Whereas the number of patients for whom residents were caring at the beginning of a call shift was significantly greater during the 4 months after the intervention than at baseline (20.24 ± 4.42 vs. 14.69 ± 4.39 , respectively, $P = 0.001$), the mean number of patients they admitted during a call shift was not significantly different after the intervention than at baseline (4.96 ± 2.67 vs. 4.86 ± 2.97 , respectively $P = 0.76$). Based on a 5-point Likert scale (1 = “slow” to 5 = “busy”),

the residents did not rate their call nights any busier after the intervention than at baseline (3.30 ± 1.11 vs. 3.02 ± 1.08 , respectively, $P = 0.25$), nor did they rate the quality of the sign-out they received any different using a 5-point Likert scale (1 = “inadequate to answer call questions” to 5 = “adequate to answer call questions”) (4.00 ± 0.77 vs. 4.08 ± 1.19 , respectively, $P = 0.47$).

Resident physicians indicated that something happened while they were on call for which they were not adequately prepared on 49 of 158 surveys (31 percent) at baseline assessment and on 62 of 168 surveys (37 percent) after the intervention ($P = 0.44$). During the baseline assessment, the residents indicated that in 40 of the 49 (82 percent) instances that something happened while they were on call for which they were not adequately prepared, there was information they did not receive during sign-out that would have helped them care for a patient overnight. At post-intervention assessment, the residents indicated that in 43 of the 62 (69 percent) instances that something happened while they were on call for which they were not adequately prepared, there was information they did not receive during sign-out that would have helped them care for a patient overnight ($P = 0.19$ as compared to baseline). These results are summarized in Figure 2.

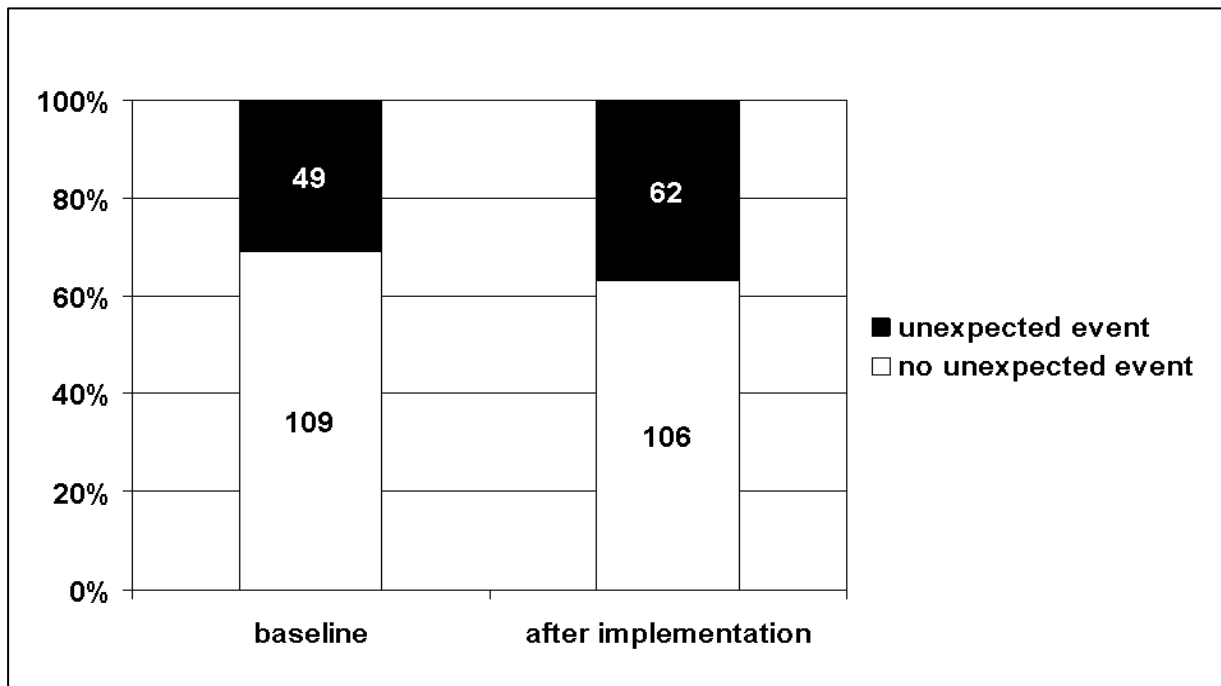


Figure 2. Percentage of call shifts with an unexpected event

During the baseline assessment, in 33 of the 40 instances (82.5 percent) in which they needed additional information, residents indicated the situation should have been anticipated and discussed during sign-out. During the post-intervention assessment, they indicated the situation should have been anticipated and discussed during sign-out in 33 of the 43 instances (77 percent) ($P = 0.59$ as compared to baseline). The number of call shifts when unexpected events occurred that the residents felt could have been anticipated and should have been discussed during sign-out was 33/158 (21 percent) at baseline and 33/168 (19.6 percent) after our intervention ($P = 0.79$). These results are summarized in Figure 3.

Residents assessed the quality of the sign-out they received using a 5-point Likert scale (1 = “inadequate to answer call questions” to 5 = “adequate to answer call questions”). During the baseline assessment and after the intervention, sign-outs for nights when something happened

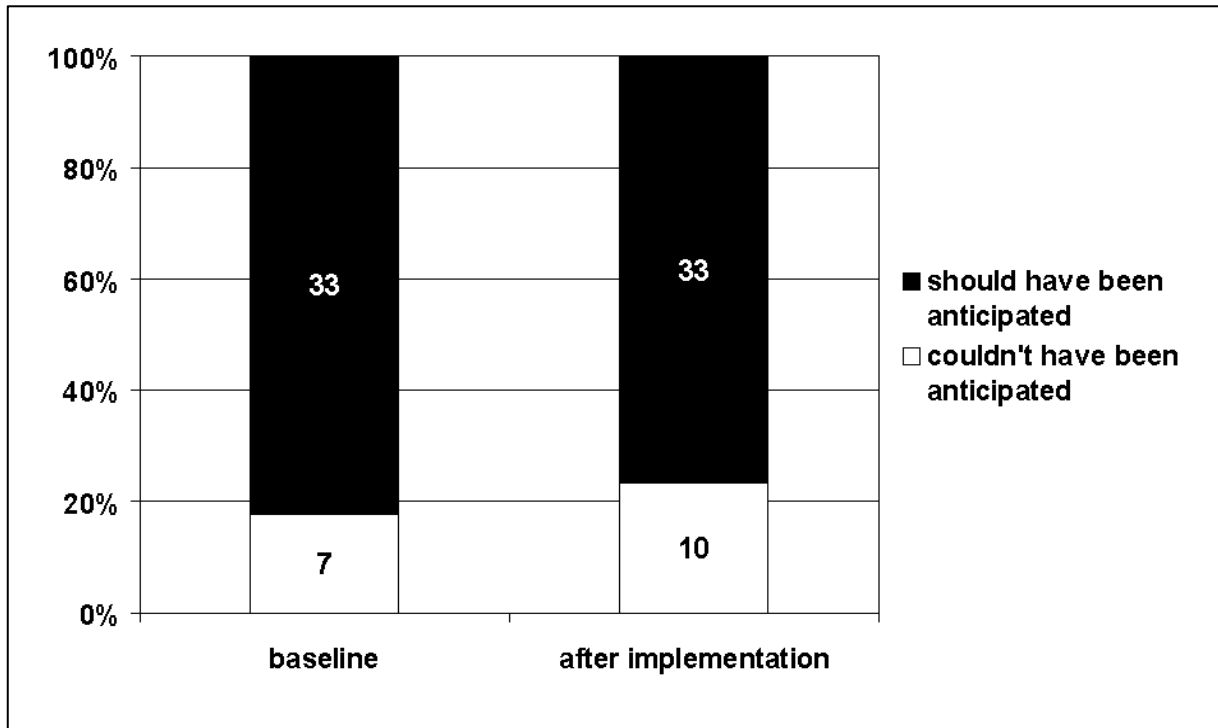


Figure 3. Percentage of unexpected events that should have been anticipated and discussed during sign-out

for which the residents were not adequately prepared were rated significantly lower than nights that nothing unexpected happened (3.58 ± 0.92 vs. 4.48 ± 0.70 , respectively, $P = 0.001$ at baseline, 3.74 ± 0.80 vs. 4.15 ± 0.71 , respectively, $P = 0.001$ after intervention).

At baseline, the likelihood of a resident experiencing an unexpected event during a call night did not appear to correspond to the number of patients the resident admitted during his call shift (4.86 ± 2.86 vs. 4.86 ± 3.21 , respectively, $P = 0.99$). However, after the intervention, residents experiencing an unexpected event during a call night tended to admit more patients during their call shifts than did residents who had no unexpected events during their call shifts (4.38 ± 2.21 vs. 5.27 ± 2.86 , respectively, $P = 0.03$).

The likelihood that a resident would experience vs. not experience an unexpected event during a call night did not seem to correspond to (1) how busy the night was (as assessed by a 5-point Likert scale (1 = “slow” to 5 = “busy”), baseline: 2.93 ± 1.07 vs. 3.25 ± 1.06 , respectively, $P = 0.08$; compared with after the intervention: 3.32 ± 1.10 vs. 3.29 ± 1.12 , respectively, $P = 0.86$, respectively; or (2) the number of patients the resident was caring for at the beginning of the call shift at baseline: 14.85 ± 4.33 vs. 14.33 ± 4.56 , respectively, $P = 0.49$; and after intervention: 20.5 ± 4.23 vs. 20.09 ± 4.54 , respectively, $P = 0.56$. These results are summarized in Table 1.

Table 1. Characterization of call nights before and after intervention

	Baseline (mean ± SD)		After intervention (mean ± SD)	
	No unexpected event	Unexpected event	No unexpected event	Unexpected event
How busy were you? ^a	2.93 ± 1.07	3.25 ± 1.06	3.29 ± 1.12	3.32 ± 1.10
How many patients were you caring for at the beginning of your call shift?	14.85 ± 4.33	14.33 ± 4.56	20.09 ± 4.54	20.50 ± 4.23
How many patients did you admit during your call shift?	4.86 ± 2.86	4.86 ± 3.21	5.27 ± 2.86	4.38 ± 2.21
Quality of the sign-out you received at the beginning of your call shift ^b	4.48 ± 0.70	3.58 ± 0.92	4.15 ± 0.71	3.74 ± 0.80

a 1 slow – 5 busy

b 1 inadequate – 5 adequate

Both during the baseline and post-intervention assessments, residents were no more likely to report events they were unprepared for when they were “cross-covering” at night than when they were members of the general pediatric ward team at baseline: 34.9 percent vs. 29.0 percent, respectively, $P = 0.60$; or after the intervention: 30.9 percent vs. 41 percent, $P = 0.20$. Similarly, both at baseline and after the intervention, when resident physicians reported an event for which they were unprepared, they were just as likely to have cared for that child previously as not: 50 percent vs. 50 percent, respectively, $P = 0.99$, at baseline; 51 percent vs. 49 percent, $P = 0.99$, after intervention.

On surveys in which residents ($N = 40$) indicated they did not receive information during sign-out that would have been helpful to them in caring for a patient overnight, they indicated where they went to get information that they did not receive during sign-out. At baseline, 14 residents (35 percent) went to the daily progress note in the chart, whereas after the intervention, only 6 (14 percent) went to the daily progress note in the chart ($P = 0.04$). At baseline, 8 residents (20 percent) reviewed the attending physician’s note, 4 (10 percent) reviewed a consultant’s note, and 10 (25 percent) reviewed nursing notes.

After the intervention, these numbers were 5 (12 percent), 4 (9 percent) and 10 (23 percent), respectively, $P > 0.3$, in every instance comparing baseline with post-intervention. At baseline 9 of the residents (22.5 percent) phoned an attending physician, 10 (25 percent) phoned a fellow, and 5 (12.5 percent) phoned a consultant. After the intervention, though, 10 of 43 residents (23 percent) phoned an attending physician, 6 (14 percent) phoned a fellow, and 1 (2.3 percent) phoned a consultant, $P > 0.1$, in every instance comparing baseline with after intervention. At baseline, in 13 of 40 instances (32.5 percent) and after the intervention, in 16 of 43 instances (37 percent), residents were unable to clearly find an answer to their question, and they used their best clinical judgment to resolve the issue ($P = 0.89$).

Discussion

The primary objective of any patient sign-out is the accurate transfer of information about the patient's current state and his or her plan of care.⁸ This transfer of information is crucial for patient safety and successful care.⁹ The risks of failing to be told, forgetting, or misunderstanding information that has been communicated during any patient care handoff are substantial.^{7, 8, 10} Incomplete information transfer and incomplete and/or unclear communication of the plan of care to covering physicians can adversely affect the quality of care.^{6, 7, 8, 9} Communication problems are judged to be the most common cause of preventable in-hospital disability or death,¹¹ and more than 60 percent of root causes of sentinel events reported to the Joint Commission have been judged to be due to failures of communication between health care personnel.¹² Resident physicians believe communication difficulties play a major role in the vast majority of medical mishaps they experience.¹³

Despite the increasing frequency and importance of sign-outs in medical practice, in most settings, sign-out remains an informal unstructured process with great variation and very little standardization, not only in the type and extent of information exchanged between care providers,^{9, 20} but also in the way and the order in which the information is conveyed.²¹ Even in the same "microenvironment," hand-offs of care can vary tremendously.²²

This variability increases the potential for omissions of information and miscommunication.^{21, 23} It may also make it difficult to anticipate which information will be received in a hand-off, leading to wasted effort invested in looking for information in other places, even if that information has been covered. Moreover, it may make hand-offs less efficient because the "rules" would have to be negotiated for each hand-off.

This study further demonstrates that resident sign-out may be a point of vulnerability. Prior to and after our interventions, on nearly one-third of the nights they were on call, resident physicians indicated that something happened for which they were not adequately prepared. In the majority of these cases, they believed the situation could have been anticipated and should have been discussed during sign-out.

Surprisingly, resident physicians were no more likely to report an event they were unprepared for if they were "cross-covering" than if they were a member of the primary team. Similarly, residents were as likely to report an event for which they were not prepared whether they had cared for the child previously or not. When we reviewed answers to open-ended questions on our survey, three themes emerged about the deficiencies of sign out:

- Sign-out is not useful if the data provided during sign-out are not up to date.
- It is important to include a rationale for the plan of care so that if changes are needed during a call shift, there is a clear context for how to best make those changes.
- Residents should try to anticipate problems that might occur during a call shift and provide contingency plans for those potential problems.

The results of this and other studies indicate that sign-out between resident physicians is often inadequate and incomplete. While no studies have examined the sign-out process between

faculty physicians or between physicians in practice, it is likely these sign-outs suffer similar shortcomings. This should not be surprising, as few training programs formally teach resident physicians how to sign-out, and even fewer programs assess a resident physician's ability to sign-out to his or her colleagues.^{4, 12, 23, 24}

Presently, sign-out is almost always learned informally "on the job." Interns and junior residents learn how to sign-out by observing more senior residents give sign-out.^{1, 4, 23, 24} A number of authors have suggested that residents should be trained to communicate effectively at the time of hand-offs of care,^{1, 5, 14, 23, 24} however, there is little evidence to guide the development of such educational programs and even less evidence on the effectiveness of any training interventions.^{12, 24} While different authors have emphasized different components and strategies to improve sign-out,^{1, 5, 14, 23} the goals and characteristics of concise and complete sign-out must be defined before any specific curriculum can be created.

Some authors have proposed computer-based sign-out systems as a means of improving the efficiency and quality of resident-sign-out.^{1, 25, 26} In the few cases where computer-based sign-out systems have been characterized and evaluated, these systems have been developed as a means of automating existing sign-out processes to make them more efficient for the providers involved.^{20, 21}

Implementation of these systems has not been accompanied by any educational intervention(s), any systematic evaluation of pre-existing sign-out processes, or by any long-term systematic assessment of the systems' effect(s) on communication and patient safety. It is possible that, while these systems may increase resident efficiency and satisfaction with the sign-out process, they may increase rather than decrease miscommunications. Whereas technologic solutions can facilitate well-designed sign-out processes, they cannot substitute for successful communication.²⁷ Effective verbal communication will almost certainly remain crucial to ensure proper transmission of essential clinical information and facilitate collaborative cross-checking.^{12, 28}

With this group of studies, as part of our intervention, we characterized the goals and characteristics of concise and complete sign-out and created a curriculum to formally teach resident physicians how to sign-out to one another. We also characterized and developed a computer-based sign-out system built to the specifications outlined by the resident physicians as a means of improving the efficiency and quality of their sign-out process.

Informally, the residents felt that these interventions had substantially improved the quality and efficiency of their sign-out; however, we did not significantly influence our primary outcome measure. The number of call nights in which unexpected events occurred that the residents felt could have been anticipated and should have been discussed during sign-out was nearly identical before and after our intervention. Moreover, the residents themselves indicated that in the majority of cases, the unexpected event could have been anticipated and should have been discussed during sign-out.

There are many potential explanations for the apparent lack of effectiveness of our interventions. First, did the residents do what they had agreed to do? Despite plans to the contrary, sign-out

continues to take place in the Pediatric Library and remains rife with interruptions. Ward sign-out often does not start promptly at 4:00 pm and often runs longer than 30 minutes. As a result, nursing staff, faculty, and other house staff continue to frequently interrupt sign-out.

Despite incorporating an acuity index on the sign-out database and enabling residents to sort patients in the database a variety of ways, the residents continue to sign-out patients in an order based upon room numbers rather than by acuity. Although we have not yet completely analyzed our sign-out recordings after our interventions, our initial impression is that during their sign-outs, many residents do not emphasize abstraction, synthesis, and summation of information, nor does every sign-out include a specific to-do list and contingency plans.

Although we developed a brief curriculum and conducted several didactic talks and role-play sessions about sign-out, this may not have been an effective means of teaching residents how to sign out more effectively and more efficiently. This process helped the residents understand the general purpose(s) of sign-out and enabled them to characterize a structured sign-out process that may facilitate sign-out. However, it did not acknowledge that the objectives of sign-out likely change with the level of the learner and his/her clinical and interpretive skills. We developed a teaching curriculum and went through several simulation exercises, but we did not conduct any formal assessment of the curriculum, nor did we perform any formal assessment of the effectiveness of our teaching interventions.

To make it easier to assimilate, organize, and transfer information at sign-out, we also provided the residents with a computerized database tool built to their own specifications. The house staff readily accepted the tool, and it rapidly became an indispensable part of their workflow. In fact, they have adapted this computerized tool for use in a variety of other settings throughout the hospital. It is conceivable that the iterative process of developing and refining the tool may have been more useful than the tool itself, in that it may have helped force some standardization of process and content.

Perhaps some of our underlying premises were incorrect. After our interventions, the residents felt ward sign-out had become more efficient and more effective, and yet, we saw no decrease in the number of unexpected events during call shifts that should have been anticipated and discussed. Perhaps the information the residents told us they needed to conduct safe, effective, and efficient sign-outs is not the information they really need to best care for their patients during call shifts.

A number of authors have suggested what an ideal sign-out should entail, and guidelines have been proposed for a standardized approach to hand-offs of care.^{29, 30, 31} However, these recommendations are not based on any hard evidence but rather on some level of consensus. We, too, used consensus building as the means of characterizing the content and process of an ideal sign-out on our pediatric wards.

While many of the questions that arise during a call shift pertain to the plan of care and its rationale,³² most of the time spent during sign-out is devoted to one-way information delivery from the residents going off call to those coming on call. Much of the information that is

conveyed is background information that is, or should be, readily available from other sources, particularly the medical record.

One unanticipated outcome of our intervention was that, following our interventions, residents faced with an unexpected event were even less likely to go to the daily progress note in the medical record. The fact that at baseline residents rarely went to the daily progress note in the medical record to try to address issues that arose while they were on call suggests that they did not expect to find the information they needed in the medical record. The medical record has increasingly been marginalized as a source of communication between clinicians. Third parties have increasingly imposed additional demands on the clinical record; courts regard patient charts as evidence in legal proceedings; and payers use the quantity and quality of documentation in medical records to justify the level of reimbursement for services.²⁷ In many settings, residents and attending physicians view the generation of documentation for the medical record as a billing and administrative function, rather than as a means of communicating important clinical information to one another.¹⁰ As a result, important clinical information may be exchanged verbally and/or through sign-out and never be entered in the medical record.^{7, 8, 10} Perhaps we further compounded this tendency by providing the residents with a “mini-medical record” in their computerized sign-out tool.

This study has a number of limitations. While the study was performed prospectively, our principal means of data collection was through post-call surveys, during which we asked resident physicians to assess the quality of the sign-out they had received when they began their call shift, and whether problems could and should have been anticipated and discussed during sign-out. These types of assessments can introduce significant hindsight bias. Moreover, many factors may influence a house officer’s assessment of the quality of the sign-out they received prior to their call shift, including the level of interpersonal trust they share with the person giving them sign-out.³³

Another potential limitation of our study is that it was performed at a single institution on a single ward service. This may limit our results’ generalizability, as there may be unique aspects to this particular acute general pediatric ward service; e.g., it is geographically located on a single floor and by its very nature involves pediatric patients who often cannot talk. Thus, there may be an increased importance of caregivers and larger variation in medication doses.

Conversely, some aspects of the study may make our results applicable to a wide variety of settings. For example, there is a relatively rapid turnover of patients, as is typical of many pediatric and medical acute ward services in university hospitals. Moreover, the study included pediatric and family medicine residents at multiple levels of training.

Conclusion

The results of this study indicate that sign-out between resident physicians is often inadequate and incomplete. Our data suggest these deficiencies are not related to the specific role of the resident physicians giving or receiving sign-out, how busy those residents are while they are on-call, or how ill the patients being cared for by the on-call residents are.

Perhaps these deficiencies are due to exchange of the incorrect information during the sign-out process. A number of residents commented on the importance of including contingency plans, as well as the rationale for the plan of care, during sign-out, so that if changes are needed during an on-call shift, there will be a clear context for how to best make those changes. This type of information often is not included during sign-out, and increasingly, it is difficult to find in the medical record. This is evidenced by the fact that nearly one-third of the time, residents were unable to find answers to questions that arose while they were on call and had to rely on their best clinical judgment.

Future studies should be directed at identifying the information physicians need while on-call and clearly describing the goals and characteristics of concise and complete sign-out. Additional studies are also needed to identify how to best teach and evaluate a physician's ability to sign-out and how technology can be employed most effectively and appropriately.

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Appendix 1: Post-Call Survey

Name _____

Today's Date _____

Post-Call Survey: We are conducting a short survey to better understand our current sign-out process. Please answer the following questions based on your most recent call night.

ALL individual results will remain strictly confidential and, when entered into the database, they will be anonymous.

1. How would you rate your most recent call night? Please circle the correlating number.

1-----2-----3-----4-----5
Slow Medium Busy

How many patients were you responsible for caring for when you started call? _____

How many patients did you admit while you were on call? _____

How many patients did you transfer to the PICU while you were on call? _____

2. Did anything happen while you were on call that you were not adequately prepared for after sign-out?

No _____

Yes _____

If you answered yes to this question, please elaborate in one or two sentences:

If you answered yes to this question please pick the most important incident that happened during your call night to answer questions 3 thru 8. If you answered NO, skip to question #9.

3. Was there information that would have been useful that you DID NOT receive during sign-out?

No _____ If you answered no to this question, please skip to question #7.

Yes _____ If you answered yes, please continue with questions 4 thru 10.

4. Where did you go to get information that you did not receive during sign-out? (check all that apply)

The chart:

Made a phone call to:

_____ resident progress note

_____ an attending physician

_____ attending physician note

_____ a fellow

_____ consultant note

_____ the chief resident

_____ the bedside chart

_____ a consultant

_____ other

_____ somebody else

The computer:

_____ MIS

_____ CareCast

_____ other

_____ Made it up as it as best I could using my clinical judgment

- Asked patient and/or patient's family
 - I couldn't get it
 - Other source not listed here, please describe
-

5. Which information sources were most useful in getting the information you required?

The chart:

A phone call to:

- resident progress note
- an attending physician
- attending physician note
- a fellow
- consultant note
- the chief resident
- the bedside chart
- a consultant
- other
- somebody else

The computer:

- MIS
- CareCast
- other

- Making it up as best I could using my clinical judgment
 - Asking the patient and/or patient's family
 - I couldn't get it
 - Other source not listed here, please describe
-

6. Should this situation have been anticipated and discussed during sign-out?

No _____

Yes _____

7. Had you previously cared for this patient (either during a previous call night or a previous day shift)

Yes _____

No _____

8. Did you write a cross-cover note (not a daily progress note) about this situation in the chart?

Yes _____

No _____

9. Overall, how would you rate the sign-out you received at the beginning of your call night?

1-----2-----3-----4-----5

Inadequate to answer
call questions

Adequate to answer
call questions

10. Do you have any other comments or suggestions about sign-out that you would like to share at this time?

*MIS = Medical Information System, which is a hospital wide computerized physician order entry system

**CareCast = computerized results and document repository