Consequences of Inadequate Sign-out for Patient Care

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Background: In case reports, transfers in the care of patients among health care providers have been linked to adverse events. However, little is known about the nature and frequency of these transfer-related problems.

Methods: We conducted a prospective audiotape study of 12 days of "sign-out" of clinical information among 8 internal medicine house-staff teams. Each day, postcall and night-float interns were asked to identify any sign-out–related problems occurring during the coverage period and to identify the associated sign-out inadequacies. We verified reported sign-out inadequacies by reviewing each corresponding oral and written sign-out. We then developed a taxonomy of types of errors and their consequences through an iterative coding process.

Results: Sign-out sessions (N=88) included 503 patient sign-outs. A total of 184 patients were signed out twice in the same night. Thus, there were 319 unique patient-days in the data set. We interviewed intern recipients of 84 of 88 sign-out sessions (95%) about sign-out–related problems. Postcall interns identified 24 sign-out–related problems for which we could verify sign-out inadequacies. Five patients suffered delays in diagnosis or treatment, resulting in 1 intensive care unit transfer, and 4 patients had near misses. In addition, house staff experienced 15 inefficiencies or redundancies in work. Sign-outs omitted key information, such as the patient's clinical condition, recent or scheduled events, tasks to complete, anticipatory guidance, and a specific plan of action and rationale for assigned tasks.

Conclusion: Omission of key information during sign-out can have important adverse consequences for patients and health care providers.

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TRANSFERS OF RESPONSIBILITY for patient care are common in academic hospitals and have increased in frequency following work-hour restrictions.[1] Yet the processes that accompany shift changes, such as sign-out of clinical information among health care providers, are rarely standardized and often haphazardly managed.[1,2] Most resident physicians receive little training in sign-out skills, are poorly supervised when conducting sign-outs, and rely on low-tech forms of communication.[1,2]

Transfers of care can precipitate a wide variety of problems,[3] including errors in prescribing medication,[4,5] evaluation,[5] and follow-up.[5,6] Frequent transfers also produce less-efficient care, such as longer length of stay and increased use of laboratory tests.[7] Retrospective interviews and case reports suggest that communication failure during sign-out is a key factor in adverse events related to transfers[8-18]; however, these studies are limited by recall and hindsight bias, and they do not provide estimates of the frequency with which adverse consequences of transfers occur. To our knowledge, no study has prospectively observed physician transfers of care before adverse events occur and then followed up patient and health care provider outcomes. Consequently, the relationship of care transfers to adverse events and the frequency with which these events occur remain poorly understood.

To address this gap, we conducted a prospective study of oral and written sign-outs followed by recipient interviews 12 to 18 hours after the sign-out to identify proximal adverse consequences. Our aims were to verify reports of inadequate sign-out practices, estimate the frequency of proximal adverse effects, and create a taxonomy of inadequacies that had immediate adverse consequences for patient care. Better understanding of the links between sign-out and subsequent problems in patient care can highlight specific ways in which transitions of care can be made safer and more effective.

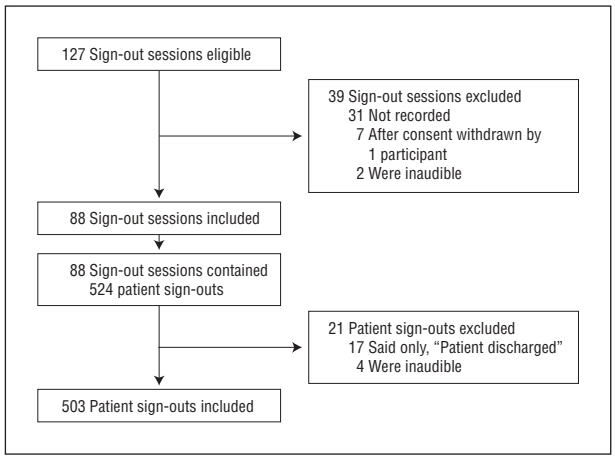

Figure. Flowchart of sign-out sessions.

METHODS

STUDY DESIGN AND DATA COLLECTION

We conducted a prospective observation study of sign-out sessions among internal medicine residents rotating on general medicine units during April 18 to April 21, 2006, and May 11 to May 19, 2006. A sign-out session included an oral sign-out of clinical information accompanied by a written sign-out sheet listing the names of patients with handwritten addenda. In addition, most interns printed a list of each patient's medications to accompany the written patient list. We recruited 3 teams for 4 days in April and 5 teams for 8 days in May. Every participating on-call intern received an audiocassette recorder in the morning and turned it on during sign-out sessions. Interns were also asked to retain copies of the written sign-outs they received. Each morning a study investigator (L.I.H., T.M., or L.W.) collected the written sign-outs and audiocassette recorders and then conducted a brief recorded interview with all postcall and night float interns using a semistructured questionnaire. The interview included the question, "Did you experience any problems relating to poor sign-out last night?" If necessary, we asked follow-up questions to determine the reasons interns attributed the problems to sign-out failures. Sign-out sessions and interviews were transcribed, and identifying information was redacted.

STUDY SAMPLE

Teams comprised 2 residents and 2 interns. Each intern/resident pair was on call once every 4 days. During on-call days, 1 intern remained in the hospital overnight to care for all patients being treated by the team. Six teams employed a night-float system; 2 did not. The night-float intern worked from 7 PM to 7 AM on a team that had gone home for the night. Thus, teams with a night-float system conducted 2 sequential sign-outs in 1 evening, first from the primary intern to an on-call intern on a different team and then from the on-call intern to the night-float intern.

Sign-out practices at Yale–New Haven Hospital were typical of internal medicine residency programs.[1] No formal sign-out training was provided to new interns. Sign-out usually took place between 2 interns. It was encouraged, but not mandated, that sign-out take place in a quiet location without interruptions.

The Human Investigation Committee of Yale Medical School approved the study and granted a Health Insurance Portability and Accountability Act waiver and a waiver of patient consent. Signed informed consent was obtained from all participating house staff and medical students.

ANALYSIS

We identified each reported problem in care and then reviewed the patient's corresponding oral and written sign-out sessions to verify whether reported failures were present. If the failure was present, we considered the problem to be verifiably sign-out related. To quantify the frequency of sign-out–related problems, we divided the number of verified problems by the number of patient-days of care in the study. We defined a patient-day of care as a 24-hour period of care for a unique patient beginning at 7 AM and ending at 7 AM the following day. Because sign-outs typically occurred between noon and 7 PM, a patient-day of care encompassed any sign-outs occurring that day and any reported clinical consequences in the next 12 to 18 hours. We obtained the number of patient-days in the study by summing the numbers of individual patients signed out each night. We produced descriptive statistics using SAS statistical software, version 9.1.2 (SAS Institute, Cary, North Carolina).

We used qualitative analysis methods[19] to describe the types of verified sign-out inadequacies that had clinical consequences overnight, following the model of "gaps" in continuity described by Cook et al.[20] We began with a list of content based on existing guidelines and literature[8,16,21-25] but inductively generated codes for clinical consequences. At least 2 of us (T.M. and L.I.H. or L.W.) independently reviewed each transcript, using the constant comparative method to assign codes.[26] The group met after each transcript to eliminate or refine codes as needed. Disagreements were resolved by negotiated consensus. We continued this process until no new concepts were being generated by review of successive transcripts. The final code structure included 10 codes about sign-out inadequacies and problems. Every transcript was then independently recoded by 2 of us (T.M. and L.I.H. or L.W.) using the final code structure, with disagreements resolved by consensus. Interrater reliability, as assessed using the κ statistic, was excellent for presence of a sign-out–related problem ($\kappa = 0.75$-0.86).[27] We used Atlas.ti software, version 5.0 (GmbH, Berlin, Germany), to facilitate qualitative analysis.

RESULTS

STUDY SAMPLE

The study sample included 88 of 127 sign-out sessions eligible for audiotaping (**Figure**). The 88 sign-out sessions were provided by 24 house staff, who conducted a mean (SD) of 3.7 (2.5) sign-out sessions each. Twenty house staff received a mean (SD) of 4.4 (4.3) sign-out sessions each. Sign-out sessions included 503 individual patient sign-outs. A total of 184 patients were signed out twice in the same night; thus, there were 319 unique patient-days in the data set. We collected computerized sign-out sheets with handwritten notes for 77 of 88 sign-out sessions (88%) and medication lists for 53 sign-out sessions (60%); we obtained both for 50 sign-out sessions (57%). Postcall interviews were completed for 84 sign-out sessions (96%). Characteristics of the sign-out sessions are shown in **Table 1**.

ADVERSE CONSEQUENCES OF INADEQUATE SIGN-OUT

Postcall staff identified 24 sign-out–related problems in patient care during 319 patient-days (7.5 problems per

Table 1. Characteristics of Sign-out Sessions

Sign-out Characteristic	No. (%) (N=88)
Degrees of separation	
0: Within primary team	18 (21)
1: Primary team to sister team	34 (39)
2: Sister team to night float	36 (41)
Relationship of sign-out provider to patient	
Own patient	48 (55)
Another intern's patient	40 (45)
Year of training of sign-out provider	
Subintern	13 (15)
Intern	58 (66)
Resident[a]	17 (19)
Sex of sign-out provider	
Male	41 (47)
Female	47 (53)
Location of sign-out	
Conference room	26 (30)
Nursing station	37 (42)
Emergency department	18 (21)

[a] Includes any sign-out session when a resident was present, even if he or she was not providing information.

Table 2. Content Omissions During Sign-out With Clinical Consequences

Type of Content Omitted	Definition
Clinical condition of patient	Patient's recent health state, including vital signs, symptoms, physical examination findings, and laboratory values; also stability and trajectory of health state
Recent or scheduled events	Events occurring during hospitalization or scheduled to occur overnight
Task	An assignment to be completed by the covering health care provider overnight
Plan	Instructions on how to complete an assigned task
Rationale	Explanation for an assigned task or plan
Anticipatory guidance	Guidance for events that might reasonably be expected to occur overnight

100 patient-days; 95% CI, 4.6-10.5). Reported problems included adverse clinical consequences for 5 patients, near misses for 4 patients, and 15 episodes of inefficient or duplicative care. We verified omissions in 1 or more of 6 main information categories in 34 sign-outs pertaining to these patients on the day the problem occurred: patient's clinical condition (n=4), recent or scheduled events (n=9), tasks to be completed overnight (n=6), anticipatory guidance (n=9), plan of action for the task or anticipated problem (n=14), and a rationale for the task or plan (n=8) (**Table 2**).

TAXONOMY OF SIGN-OUT OMISSIONS

Current Clinical Condition Omitted

When the current clinical condition of the patient was omitted during sign-out, it was difficult for health care providers to prioritize care or identify clinical deterioration. For example, one patient was sent to the intensive care unit in the middle of the night because of significant bronchospasm. Only then did the covering intern discover that the patient had been bronchospastic during the day as well; this condition was omitted from the oral and written sign-out. As the postcall intern reported the next day, "I had a patient who I had to send to the unit. She had some unanticipated significant bronchospasm, and apparently she had been a little bit bronchospastic during the day, and this wasn't an issue that had really been discussed. So that was kind of the bad thing."

Recent and Scheduled Events Omitted

Interns also had difficulty caring for patients when they did not know what events had recently occurred or were planned for the night. For instance, one patient with diabetes mellitus had her insulin withheld because of hypoglycemia. However, this information was omitted from the oral and written sign-outs:

Oral sign-out (fourth-year medical student): "OK, so this young woman, she came in with LFTs [results of liver function tests] in the thousands. But she also had, she had something else. [pause] OK. Yeah, I guess it was just this. So they, I think they just think it's a viral hepatitis. I don't know why she's still here. I guess they're just waiting for her LFTs to normalize again, and then they're going to send her home."

Written sign-out: "29 y/o [-year-old] with hx [history] of DM [diabetes mellitus], pancreatitis due to increased TG [triglycerides], presented with abnl [abnormal] LFTs and heterogeneous liver and pancreas in US [ultrasound]."

That evening, the nurse called the night-float intern to report that the patient's blood glucose level was in the 200s but that she was not receiving her usual insulin. Because the sign-out omitted an important recent event—that the patient had been hypoglycemic while receiving her usual insulin regimen as a consequence of her acute illness—and failed to provide anticipatory guidance about the possibility of rising blood glucose levels as the patient recovered, the night-float intern was obliged to perform a detailed medical record and laboratory review to answer a relatively minor question. The patient suffered no permanent harm, but the incident was time consuming and distracted the intern from other tasks.

Anticipatory Guidance Omitted

Failure to provide anticipatory guidance for likely overnight events resulted in some of the most serious problems observed by covering interns. For example, one patient who had seizures repeatedly during her hospitalization was signed out without any guidance about effective treatment:

Intern signing out: "Mrs [Name]. She's a 58-year-old with severe COPD [chronic obstructive pulmonary disease], hepatitis B and C, polysubstance abuse with a history of withdrawal seizures, who was admitted initially

to the MICU [medical intensive care unit] in respiratory distress because of her COPD but has now had a complicated hospital stay, such as seizures."

Intern receiving sign-out: "Mm-hmm. Because she's off her benzos [benzodiazepines]?"

Intern signing out: "Exactly. Off her benzos. But she's been controlled; she hasn't had a seizure in a week. But recently complicated by a gallstone and common bile duct obstruction. So she had an ERCP [endoscopic retrograde cholangiopancreatography] 4 days ago. She's been doing fine. She had some nausea/vomiting this morning but secondary to migraines, not really secondary to her abdominal surgery. And she's on cipro [ciprofloxacin; Bayer Schering Pharma, Berlin, Germany]/flagyl [metronidazole; Pfizer, New York, New York] and linazolid. If anything happens, call ERCP. She was doing fine when I left her."

This patient had seizures again overnight, and the cross-covering intern had to spend substantial time reviewing the medical record to determine the patient's new medication regimen, results of recent imaging studies, and the best course of action, rather than already having this information at hand. This was not only a burden for the covering physician but resulted in delayed care for the patient.

Task Not Assigned

In several cases, the sign-out omitted an assignment to follow up the result of a test performed during the day. This meant that abnormal results could be overlooked. For instance, one patient underwent ultrasonography on the day of the sign-out to monitor a large abscess that had first been diagnosed by an earlier ultrasound. The new ultrasound image showed no improvement despite surgical intervention. However, the patient was signed out to the intern covering that evening with no mention of the second ultrasound, no assignment to check the results, and an ambiguous assignment to follow up a new consult note:

"[Name], 48-year-old guy who came in with cellulitis 5 weeks ago, kind of got worse. Lower extremity ultrasound showed that there was an abscess—like 8 cm by 2 cm. Surgery came and drained it a couple of days ago. It's been draining fluid—I went in this afternoon and the pillow was wet with serosanguinous fluid, but it's not frank blood or anything. But he's clinically really stable, really good, hasn't been febrile for the last 2 days or so. So there's probably nothing to do. So yeah, that's right, ID [infectious disease] was consulted; they haven't put a note in yet. They'll probably put one in later. They might not even; they might be done for the day. So that's it on him."

The covering intern only discovered that the second ultrasound had been performed and had shown no improvement when the ID consultant paged him to ask that the surgery department be called to make another attempt at drainage.

Plan Not Provided

Several interns reported that they were assigned tasks without being told how best to complete them. For example, an intern was told to discontinue treatment with an insulin drip without being told what subcutaneous insulin regimen to use afterward, another was instructed to send a patient for a vascular study without being told what to do about the patient's anticoagulation afterward, and others were asked to replete potassium levels in patients with renal failure without being told what dosage was typically effective. These examples highlight the fact that interns frequently had to improvise plans for medications with high potential for harm if prescribed incorrectly, such as insulin, anticoagulants, and potassium.

Rationale Not Provided

Even if a task included a plan of action, health care providers were unable to deal efficiently or effectively with unanticipated sequelae if they did not fully understand why the task was assigned in the first place. For example, the neurosurgery service requested that one patient undergo an urgent magnetic resonance imaging (MRI) scan to help determine whether he would require surgical treatment for a brachial plexus injury. The patient's primary intern scheduled the MRI and asked the covering intern to check the results and call neurosurgery when it was completed. She stressed the high-priority nature of the study but did not fully explain why it had been ordered. That evening, the conscious sedation nurse on call, who was pregnant, declined to assist with the procedure. As the night-float intern reported the next day: "And there was a patient who was supposed to get an MRI, and I was told it was very important, but it wasn't clear why it was important. . . . So . . . when I couldn't get it done, I wasn't clear on how important it was [to push for the study]."

The night-float intern was faced with the choice of calling in another nurse from home or deferring the test but was unsure what to do because he was unaware of the precise indication for the MRI. In the end the patient did not receive an MRI that night, delaying his diagnosis.

OTHER SIGN-OUT CONTENT INADEQUACIES

Two reported problems did not involve specific sign-out omissions. In one case, a patient with hypotension in the step-down unit was omitted from the oral and written sign-out session, resulting in confusion and delayed care. In the second case, an alcoholic patient's sign-out focused on his unusual presentation of severe hypertryglyceridemia, while his concomitant alcohol withdrawal anxiety was misattributed to a panic attack. As the night-float intern reported in an interview the next day: "He was clearly a heavy alcohol user, and there wasn't any mention on the sign-out about watching for withdrawal, and he had been tachycardic all day. So then he began to become more agitated. And right now, as we speak, we're going to be restraining him and giving him some IM [intramuscular] Ativan [lorazepam; Wyeth-Ayerst, Madison, New Jersey] and see how he does. But . . . it just was something I wasn't aware of from the get-go, from the person who made the sign-out."

In fact, the possibility of alcohol withdrawal had been mentioned in both oral sign-out sessions. However, this warning was obscured for the listener by a distracting presentation, a misframing of the patient's symptoms as situational panic, and omission from the written sign-out.

COMMENT

Our findings make explicit the connection between inadequate communication among house staff at the time of transfer of responsibility and adverse consequences experienced several hours later by patients or health care providers. Sign-out–related problems occurred with some frequency—7.5 per 100 patient-days of care—and contributed to adverse clinical consequences for patients, near misses, and inefficient or duplicative work by health care providers.

This study highlights the hidden toll inadequate sign-out takes on timely and efficient care. Most adverse events experienced by patients or their health care providers were delays, inefficiencies, and duplication of effort. Similar consequences of communication failure have been described in other health care settings.[8,28,29] The cumulative effect of such inefficient care can be profound, not only harming patients but diverting residents from more important tasks, such as patient care, education, and rest. Residents now spend a third of their time on activities of marginal educational value, such as seeking documentation and laboratory results[30]; conversely, seriously ill patients are visited by house staff a mean of only 27 minutes a day and spend more than 18 hours per day alone.[31]

Most errors were related to omissions of content that required synthesis and judgment, such as an estimate of the clinical condition of the patient, a plan for completing a task, or anticipation of events that might occur overnight. Previous studies[8,12,15,16,18,28] have noted that sign-out content plays an important role in errors. Our results suggest that to reduce errors, we should focus specifically on content that conveys an overall picture of the patient and assists with decision making. Such standardization has been lacking to date.[32] We propose that the taxonomy of content omissions reported in this study can serve as an evidence-based list of recommended content for sign-out communication.

One means of prompting comprehensive sign-out content is to standardize sign-out format and order. Written templates for sign-out result in more consistent and accurate content than free-text sign-out.[33-36] Although written sign-outs using templates still contain a high rate of omissions and inaccuracies,[34,35,37] they have been shown to reduce errors.[38] Likewise, recall improves when oral information is presented in a consistent order and fits into an expected framework,[39] such as that used for the admission history and physical examination. Based on the results of this study, we developed an ordered mnemonic for internal medicine oral sign-out sessions,[40] and others are also being developed.[41-43]

Although content is clearly important, errors were not solely the result of missing information. In one case, the sign-out assigned an incorrect diagnosis of panic attack to a patient with alcohol withdrawal. This prompted the recipient to misinterpret later symptoms (a form of "anchoring bias"[44]), resulting in delayed diagnosis and treatment. The availability heuristic, in which clinicians place undue importance on recent or vivid experiences,[44] confirmation bias, and stereotyping are some of the many other factors that can adversely affect clinical judgment and sign-out quality. Similarly, Reason's "Swiss cheese" model of error emphasizes that failures in multiple lines of defense are typically involved in an error that causes harm to patients.[45] Analysis of near misses helped us to identify numerous defenses that mitigated sign-out failure, including intervention by other physicians or nurses, the availability of other sources of clinical information, good judgment and extra effort by covering health care providers, and patients' own resilience.

These findings suggest several avenues for future research regarding sign-out processes, outcomes, and interventions. Physicians use many information sources and interact with multiple staff members to provide care at night. Thus, future research using prospective, direct observation designs in multicenter settings may examine whether information technology, social and hierarchical relationships, workload, day of the week, and training level affect sign-out quality. The prevalence of delayed care in the 12-hour period following sign-out suggests that there may also be effects on longer-term outcomes, such as length of stay. Finally, our list of key content can be used to inform the development and assessment of educational and technological interventions to improve sign-out.

Our study has some limitations. It was performed among internal medicine house staff at a single institution in the spring, and results at other times or in other institutions or other specialties may differ. However, the sign-out process at this institution is similar to that found in other internal medicine residency programs.[1] A number of factors likely led to an underestimation of the frequency of sign-out–related problems. First, we did not include transfers back from night-float or postcall staff to the primary team in the morning; transfers between units, services, or settings; or transfers among nurses, attending physicians, or consultants, all of which may also be associated with error. Second, participants noted that sign-outs improved during the study, possibly averting some errors. Third, adverse events may have occurred without the knowledge of the covering intern, or the contribution of inadequate sign-out may not have been recognized. Last, we only assessed outcomes occurring within 12 hours of sign-out. Consequently, our estimate of the frequency of sign-out–related events is likely a lower bound of the magnitude of the problem.

In summary, we found that poor sign-out processes contribute to substantial inefficiencies and delays in care, as well as occasional patient harm. A major factor was failure to convey an accurate overall picture of the patient or to assist with overnight decisions. This suggests that efforts to improve the safety and efficacy of transfers should include a focus on consistent provision of higher-order sign-out content containing synthesis and judgment.

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Author Contributions: Drs Horwitz, Moin, Krumholz, and Bradley had full access to all of the data in the study and take responsibility for the integrity of the data and

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