Effect of Audit and Feedback on Improving Handovers: A Nonrandomized Comparative Study

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Abstract

Background High-quality, shift-to-shift handovers by residents are critical to ensuring to patient safety. The 2011 Accreditation Council for Graduate Medical Education duty hour requirements have increased the number of handovers occurring daily, necessitating new approaches to this challenge. Research suggests standardized approaches, electronic systems, and education programs can improve the handover process.

Methods We conducted a 2-phase, observational study comparing an electronic handover system (experimental) in one clinical setting to a standard card-based system (control) at a second site. Outcome data included an objective assessment of the completeness and accuracy of handovers, and resident assessment of the handover systems. In phase 1, data were recorded at both sites and not shared with residents. In phase 2, data from the experimental system were used to provide standardized feedback to residents on the quality of their handovers.

Results A total of 3184 individual patient sign-outs were evaluated during the 11-month period. Following introduction of a feedback intervention in the experimental arm, errors were present in only 5.2% of handovers, compared with 16.1% of controls ($P < .001$), and 67% of the 38 residents responding reported they perceived the experimental system as facilitating better patient care.

Conclusion Regular, real-time feedback through an electronic handover system can improve the accuracy and completeness of handovers in patient care.

Background

High-quality, shift-to-shift handover of patient care responsibility by residents is critical to ensuring patient safety in teaching hospitals.[1–5] The Accreditation Council for Graduate Medical Education's (ACGME's) 2011 work hour restrictions significantly increase the number of handovers,[6] and the need for effective handovers has never been greater.

The ACGME rules mandate that "institutions and programs must ensure and monitor effective, structured handover processes to facilitate both continuity of care and patient safety."[6(p13)] Previous studies suggest various frameworks for this, including templated handovers,[7,8] electronic systems,[9,10] and handover education,[11] but studies comparing different handover techniques have been sparse. We report a single program's experience with switching to an electronic handover system with education and real-time feedback interventions and compare the efficacy of this system with that of a traditional template-card handover system.

Methods

Objectives

We sought to determine which system would provide the most complete, accurate, and safe handovers of patient care. The intervention was designed according to the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) statement.[12]

Design

We used a nonrandomized, comparative design. Residents rotated between 2 campuses, and the investigators were blinded to their assignment. One campus implemented the electronic handover and educational interventions (experimental system), whereas the other continued to use a

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preexisting card-based system (control system). The systems were evaluated for completeness, accuracy, and perceived safety of care. This study was reviewed and received exempt status from the Institutional Review Board.

Setting

Aurora Health Care's internal medicine inpatient service comprises Aurora Sinai Medical Center (ASMC) and Aurora St Luke's Medical Center (ASLMC). The ASMC is a 197-bed general medical and surgical hospital. The ASLMC is a 730-bed tertiary referral hospital. Approximately 70% of residents rotated at both sites during the intervention.

Control System

The preexisting system at ASLMC was a card-based handover using templated cards. A face-to-face handover occurred at the end of each workday between interns with an overview of what events were expected overnight. The following day, cards were placed in a single location for pickup, where any events would be recorded. Handover back to the original team was encouraged to be face-to-face. On discharge, cards were placed in a collection receptacle for auditing and data collection.

The investigators were not involved in the design or implementation of the control system at ASLMC and did not implement additional education or feedback measures at that site.

Experimental System

The ASMC chose the Reliable Electronic Clinical Signout system (NextMed Technologies Inc, Boston, MA).[13] The application is a web-based database that can be exported to a printable file for all patients being covered. Similar to the card system, residents were expected to make a face-to-face handover at shift changes.

What was known

Teaching residents how to do high-quality handovers is important to the quality of care, and required by the ACGME's 2011 common program requirements.

What is new

Use of an electronic handover system with real-time feedback resulted in significantly lower errors in the intervention group (5.2%), compared to a control group using a standard card-based handover (16.1%).

Limitations

Single specialty (internal medicine), single program sample; lack of randomization; use of surrogate measures for quality of care.

Bottom line

A simple intervention with real-time feedback through an electronic system improved objective assessments and resident ratings of the accuracy and completeness of handovers. Feedback may have had the largest effect on outcomes.

Quality Audits

The study was conducted in 2 phases. In phase 1, the electronic handovers were audited and data were not shared with residents or faculty. In phase 2, the results of the audits were shared with residents and faculty to provide standardized, individual feedback. To evaluate accuracy, we used the data contained in the electronic medical record (EMR) as a benchmark.

Based on previous research, code status and allergies were selected as endpoints to evaluate sign-out quality in phase 1.[14] Daily audits were performed from July 2010 through October 2010 on both systems (TABLE). Auditors were not blinded as to which system the handover originated. Data from this phase were not disclosed to the residents during this time,

TABLE **Variables and Interventions Used in Each Phase of the Study**

Phase	Variables Audited	Interventions
Phase 1	▪ Allergies omissions ▪ Allergy errors ▪ Code status omissions ▪ Code status errors	▪ Control site: none ▪ Experimental site: implementation of electronic sign-out system
Phase 2	▪ Allergies omissions ▪ Allergy errors ▪ Code status omissions ▪ Code status errors ▪ Identification statement omissions ▪ Anticipatory guidance omissions	▪ Control site: none ▪ Experimental site: continued electronic system, implemented real-time feedback on weekly basis to individual residents

although they were aware of the intervention. At the end of phase 1, the experimental system was consistently underperforming relative to the card system.

We conducted feedback sessions with residents, and these discussions revealed the sections being audited were not the fields considered most important because of their redundancy with EMR data. Residents were most concerned about having accurate identifying information on patients, including a chief complaint (identification statement), location, and the inclusion of anticipatory guidance (if-then statements).

Several endpoints and the methods for evaluating handovers were altered in November 2010 for phase 2 (TABLE). Audit frequency with the electronic system was reduced to a weekly cross-section of active handovers because of time considerations. Mean length of stay for patients on teaching teams at ASMC for all diagnostic related groups is less than 1 week; thus, the number of handovers audited more than once during a hospitalization was minimal.

Group and individual education interventions were introduced in phase 2. Educational sessions on using the electronic sign out and the importance of quality handovers were performed each month. Also, weekly audits were used to generate a standard feedback report for each resident.

Survey

At the end of phase 2, we sent an anonymous survey to all residents asking about their confidence in their handover, system ease of use, and perceived safety. Results were reported as either yes/no preference questions or on a 7-point Likert scale. The survey was administered anonymously using a web-based application.

Statistical Methods

Data were de-identified and aggregated into 1-month segments for analysis. Error and accuracy data were analyzed using the standard error of proportion and relative risk and χ^2 analysis in a Mantel-Haenszel model. Survey data were analyzed using descriptive statistics for normal data.

Results

In phase 1, the 627 experimental and 502 control handovers were audited. In phase 2, the 726 experimental

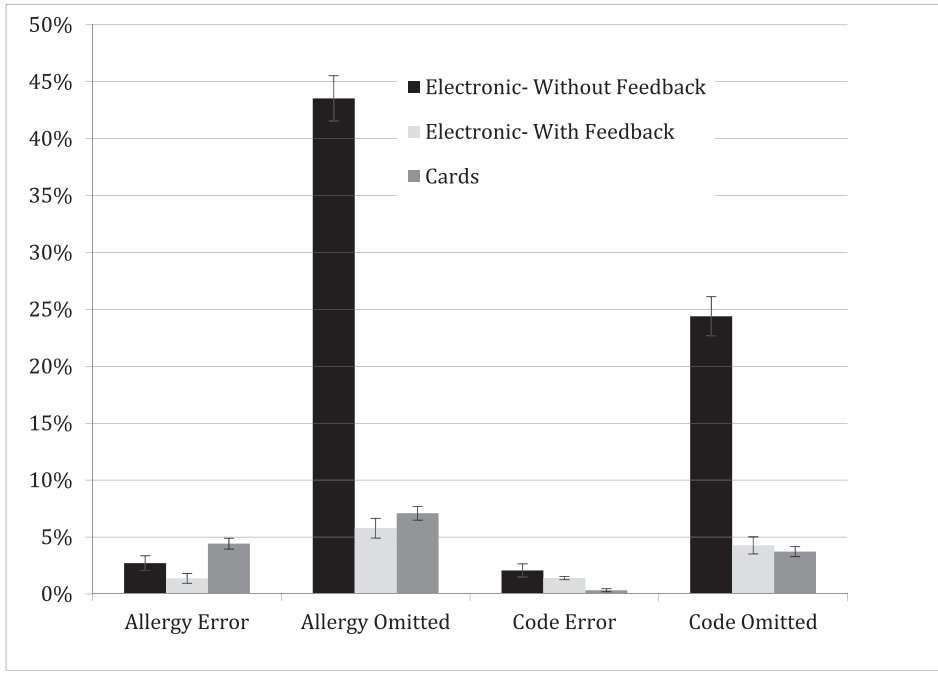

FIGURE 1 **Allergy and Code Errors and Omissions—Errors and ommisions for Both Phases in the Study Are Shown.** Error Bars Represent Standard Error of the Mean; Allergies With Errors Were Present in 2.7% of Electronic Handovers Before Feedback, 1.4% After Feedback, and 4.4% of Cards; Allergies Were Omitted in 44% of Electronic Handovers Before Feedback, 5.8% After Feedback, and 7.1% of Cards; Code Errors Were Present in 2.1% of Electronic Handovers Before Feedback, 1.4% After Feedback and 0.3% of Cards; and Code Status Was Omitted in 24% of Electronic Handovers Before Feedback, 4.3% After Feedback and 3.7% of Cards

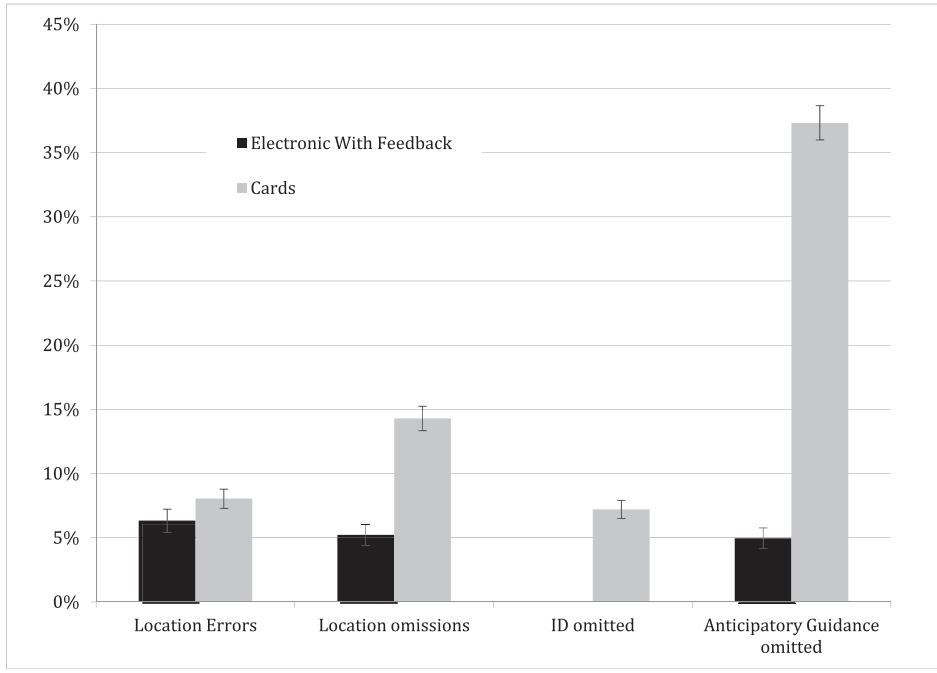

FIGURE 2 **Phase 2 Outcomes.** Error Bars Represent Standard Error of the Mean; Location Errors Were Present in 6.3% of Electronic Handovers Receiving Feedback and 8.1% of Cards; Location Data Were Omitted in 5.2% of Electronic Handovers Receiving Feedback and 14.3% of Cards; Complete Identification Data Were Omitted in No Electronic Handovers Receiving Feedback and 7.2% of Cards; Anticipatory Guidance Was Omitted From 5.0% of Electronic Sign-outs Receiving Feedback and 37.3% of Cards

and 1329 control handovers were evaluated. Chi-squared analysis did not yield any difference in the number of card errors between phases 1 and 2 ($P = .44$). The experimental handover showed no significant trends except at the transition between phases ($P < .001$).

In phase 1, differences in allergy error rates between the systems did not reach statistical significance. With phase 2 interventions, allergy errors were reduced relative to control (FIGURES 1 and 2).

In phase 1, omissions of allergy and code status were both significantly more common with the experimental system. Neither differences in allergy omissions nor code omissions reached statistical significance in phase 2 (FIGURE 2).

Phase 2 outcomes are reported in FIGURE 2. Location errors and omissions were both significantly less common with the experimental system. Anticipatory guidance was significantly better with the experimental system with far fewer electronic handovers omitting this information compared with controls.

A notable result of the study was the effect of feedback. The experimental system was inferior to cards until the experimental handover system was used to provide residents and faculty with individualized reports on the quality of handovers. The improvement in the quality of the handover was immediate and sustained throughout the intervention. The amount of time required for this intervention was minimal (45 min/wk).

Survey Data

Our survey response rate was 59% (30 of 51). On a 7-point Likert scale with 1 being *not at all comfortable* and 7 being *very comfortable*, residents reported their confidence in their own handover at 6.17 (95% confidence interval [CI], 5.92–6.42). Confidence in handover received with the experimental system was 5.63 (95% CI, 5.3–5.97) and 5.1 (95% CI, 4.71–5.49) with the control system. Face-to-face sign-out occurred more consistently at the experimental site when measured during phase 1 (85%, 34 of 40 versus 46%, 13 of 28). Sixty-seven percent (20 of 30) of residents reported they preferred the experimental system, and the experimental system was perceived as being better for patient care; 27% (8 of 30) reported the 2 systems to be comparable. The remaining 7% (2 of 30) preferred the control system; 57% (17 of 30) reported that the control system was faster to use, 37% found the experimental system was quicker (11 of 30), and 7% (2 of 30) perceived no difference. In addition, several residents commented that

they preferred to give sign-out with the control system because of its ease of use but preferred to receive the experimental sign-out because of patient safety.

Discussion

Once feedback was included, the experimental system was significantly better in the accuracy of handovers and the inclusion of anticipatory guidance.

Code status and allergy data, the original endpoints of the study, were not strikingly different between the experimental and control results in phase 2. One possible reason for this is that these data were easily obtained in the EMR and were excluded because of the redundancy of these data. Residents did not prioritize these data during focus groups, supporting this conclusion. The aversion to duplicating information may suggest a role for integrated EMR/handover systems.

It is somewhat surprising that there were no significant trends noted outside of the transition period. We expected a gradual improvement in the handover quality over time after the feedback intervention but, instead, saw an immediate improvement that reached a plateau within the first month. This may be due to our residents rotating on monthly blocks, and thus, each new month represented a largely new group of residents.

Residents placed a high value on anticipatory guidance inclusion. Sixty-three percent (833 of 1329) of control handovers included this vital information, compared with 95% (690 of 726) during phase 2 experimental handovers. The superiority of the experimental system in this area correlates with the resident perception of the experimental system as better for patient care.

Our study has several limitations. First, we used process compliance as a surrogate marker for adverse patient outcomes. Second, we limited our process variables to written communication only. Third, the data-collection methods at the 2 sites varied slightly, using a cross-section of active handovers at ASMC and an audit of discharged patients at SLMC. Fourth, we evaluated only whether anticipatory guidance was present on handovers, but not the quality of that guidance. It is possible that several handovers had anticipatory guidance entered once, and then were never updated to reflect changes in the clinical situation. Finally, computerized physician order entry was implemented during the intervention at both sites between August and October. This may have confounded the results of the study during phase 1, but by phase 2, these changes had been well established and should not have affected the results.

Resident perception was that the phase 2 electronic system, although slightly more time consuming, was significantly safer for patient care. This correlated with improved inclusion of anticipatory guidance statements in the electronic system. Our institution is currently implementing the electronic system at both campuses. Chief residents will continue to perform weekly audits and provide individual feedback. Faculty will incorporate data from these audits into the end-of-month evaluations of resident performance.

Conclusion

Overall, our findings support the use of a regular feedback handover system to improve handovers and the use of an electronic product to facilitate that process. This is consistent with prior studies.[7–9] A previous study[15] used recordings of the handover process to assess the quality of handovers, and the verbal and interactive aspects of sign-out are important aspects of the process for future studies. Integration of handover instruction and evaluation into a graduate medical education program is critical to addressing the gaps in care.

References

1. Kitch BT, Cooper JB, Zapol WM, Marder JE, Karson A, Hutter M, et al. Handovers causing patient harm: a survey of medical and surgical house staff. *Jt Comm J Qual Patient Saf*. 2008;34(10):563–570.
2. Hinami K, Farnan JM, Meltzer DO, Arora VM. Understanding communication during hospitalist service changes: a mixed methods study. *J Hosp Med*. 2009;4(9):535–540.
3. Solet DJ, Norvell JM, Rutan GH, Frankel RM. Lost in translation: challenges and opportunities in physician-to-physician communication during patient handovers. *Acad Med*. 2005;80(12):1094–1099.
4. Petersen LA, Brennan TA, O'Neil AC, Cook EF, Lee TH. Does housestaff discontinuity of care increase the risk for preventable adverse events? *Ann Intern Med*. 1994;121(11):866–872.
5. Lofgren RP, Gottlieb D, Williams RA, Rich EC. Post-call transfer of resident responsibility: Its effect on patient care. *J Gen Intern Med*. 1990;5(6): 501–505.
6. [ACGME] Accreditation Council for Graduate Medical Education. Duty hours: proposed standards for review and comment: 2010. http://acgme-2010standards.org/pdf/Proposed_Standards.pdf. Updated June 23, 2010. Accessed January 30, 2012.
7. Lee LH, Levine JA, Schultz HJ. Utility of a standardized handover card for new medical interns. *J Gen Intern Med*. 1996;11(12):753–755.
8. Chu ES, Reid M, Schulz T, Burden M, Mancini D, Ambardekar AV, et al. A structured handover program for interns. *Acad Med*. 2009;84(3):347–352.
9. Bernstein J, MacCourt DC, Jacob DM, Mehta S. Utilizing information technology to mitigate the handover risks caused by resident work hour restrictions. *Clin Orthop Relat Res*. 2010;468(10):2627–2632.
10. Kochendorfer KM, Morris LE, Kruse RL, Ge BG, Mehr DR. Attending and resident physician perceptions of an EMR-generated rounding report for adult inpatient services. *Fam Med*. 2010;42(5):343–349.
11. Nabors C, Peterson SJ, Lee WN, Mumtaz A, Shah T, Sule S, et al. Experience with faculty supervision of an electronic resident handover system. *Am J Med*. 2010;123(4):376–381.
12. Des Jarlais DC, Lyles C, Crepazm N; TREND Group. Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. *Am J Public Health*. 2004; 94(3):361–366
13. NextMed Technologies. Reliable electronic clinical signout. Ver 3.0.2. http://www.nextmedtech.com; Accessed: January 30, 2012.
14. Van Eaton EG, Horvath KD, Lober WB, Pellegrini CA. Organizing the transfer of patient care information: the development of a computerized resident sign-out system. *Surgery*. 2004;136(1):5–13.
15. Borowitz SM, Waggoner-Fountain LA, Bass EJ, DeVoge MS. *Resident Sign Out: A Precarious Exchange of Critical Information in a Fast Paced World. Advances in Patient Safety: New Directions and Alternative Approaches*. Culture and Redesign. Vol 2. Rockville, MD: Agency for Healthcare Research and Quality; 2008.

We report and correct an error in *J Grad Med Educ*. 2010;2(3):316–321:

Rinard R, Garol BD, Shenoy AB, Mahabir RC. Successfully matching into surgical specialties: an analysis of national resident matching program data. *J Grad Med Educ*. 2010;2(3):316–321.

The author list has been modified. All other content remain unchanged.

We report and correct an error in the spelling of Dr Mohamed Omballi's name:

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