the attention of professional societies and government agencies charged with promoting antimicrobial stewardship.

Peter K. Lindenauer, MD, MSc
Mihaela S. Stefan, MD, PhD
Laura C. Feemster, MD, MS
Meng-Shiou Shieh, PhD
Shannon S. Carson, MD
David H. Au, MD, MS
Jerry A. Krishnan, MD, PhD

Author Affiliations: Center for Quality of Care Research, Baystate Medical Center, Springfield, Massachusetts (Lindenauer, Stefan, Shieh); Division of Hospital Medicine, Baystate Medical Center, Springfield, Massachusetts (Lindenauer, Stefan); Department of Medicine, Tufts University School of Medicine, Boston, Massachusetts (Lindenauer, Stefan); Veterans Affairs Health Services Research and Development, Center of Innovation for Veteran-Centered and Value-Driven Care, Seattle, Washington (Feemster, Au); Division of Pulmonary and Critical Care, University of Washington, Seattle, Seattle, (Feemster, Au); Division of Pulmonary and Critical Care, University of North Carolina, Chapel Hill (Carson); Population Health Sciences Program, University of Illinois Hospital and Health Sciences System, Chicago (Krishnan).

Corresponding Author: Peter K. Lindenauer, MD, MSc, Center for Quality of Care Research, Baystate Medical Center, 280 Chestnut St, Third Floor, Springfield, MA 01199 (peter.lindenauer@baystatehealth.org).


Author Contributions: Dr Lindenauer had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of data analysis. Study concept and design: Lindenauer, Stefan, Feemster, Carson, Au, Krishnan. Acquisition, analysis, or interpretation of data: Lindenauer, Stefan, Feemster, Shieh, Carson, Au, Krishnan. Drafting of the manuscript: Lindenauer. Critical revision of the manuscript for important intellectual content: All authors. Administrative, technical, or material support: We have all reviewed the final version of the manuscript and approve it for publication.

Conflict of Interest Disclosures: None reported.

Funding/Sponsorship: This study was supported by grants K01 HL114631 (Dr Stefan) and K23 HL111116 (Dr Feemster) from the National Heart, Lung, and Blood Institute of the National Institutes of Health and the Veterans Affairs Health Services Research and Development (Drs Feemster and Au).

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

Disclaimer: The views expressed here are those of the authors and do not necessarily reflect the position or policy of the US Department of Veterans Affairs or the US government.


Association of a Web-Based Handoff Tool With Rates of Medical Errors

Communication among health care personnel is vulnerable to error during patient handoffs (ie, the transfer of responsibility for patient care between health care professionals). Handoffs occur with high frequency in the hospital and have been increasing following restrictions of resident work hours.1 However, to our knowledge, there remains a lack of rigorously performed studies that help guide best practices in handoffs of hospitalized adult patients. In this study, we implemented a web-based handoff tool and training for health care professionals, and evaluated the association of the tool with rates of medical errors in adult medical and surgical patients.

Methods | We conducted a prospective cohort analysis from November 1, 2012, to February 1, 2014, of 5407 patients on 3 general medicine services and 2 general surgery services at Brigham and Women’s Hospital during 1 data collection period before implementation of a web-based handoff tool and 2 periods after implementation.2 Between periods 2 and 3, general medicine services (but not surgical services) underwent restructuring to regionalized care teams (Figure).3,4

To screen for potential errors, validated surveillance surveys5 were administered to “nightfloat” (working 12 AM to 7 AM) and “twilight” (working 4 PM to 12 AM) residents on completion of their shifts, and to residents and attending physicians 2 days after starting on the general medical or surgical service, querying for potential errors, followed by targeted review of medical records. All incidents were rated on presence of errors and level of harm using the National Coordinating Council for Medication Error Reporting and Prevention scale6 and on attribution to failures in communication and handoff. Injuries with harm (adverse events) were additionally rated on preventability.3 All ratings were adjudicated by a physician who was unaware of the time period; discrepancies in ratings prompted review of medical records, with final determination by the adjudicator (S.K.M.). The study was approved by the Partners Healthcare Human Subjects Review Committee. The need for patient consent was waived by the institutional review board as this was a hospital-wide quality improvement initiative with additional focused teamwork and tool training on the implementation units.

Patient characteristics were compared using χ2 or t tests. All outcomes were converted to errors per 100 patient-days (error rates), which were compared in period 1 vs 2 and 3 using multivariable Poisson regression (SAS, version 9.3; SAS Institute), clustering by role and adjusting for covariates.

Results | Of the 5407 total patients, 77 medical errors were detected before the intervention vs 45 after the intervention. Primary and secondary outcomes (Table) are notable for significant reductions in total medical error rates per 100 patient-days (period 1 rate, 3.56; 95% CI, 1.70-7.44; period 2 and 3 rate, 1.76; 95% CI, 0.93-3.31; P < .001), errors owing to failures in communication (period 1 rate, 2.88; 95% CI, 1.22-6.82; period 2 and 3 rate, 1.15; 95% CI, 0.76-1.74; P < .001), er-
errors owing to mistakes in handoffs (period 1 rate, 2.47; 95% CI, 1.00-6.07; period 2 and 3 rate, 0.95; 95% CI, 0.56-1.61; \( P < .001 \)), errors from end-of-shift (but not end-of-rotation) handoffs (period 1 rate, 6.93; 95% CI, 5.36-8.76; period 2 and 3 rate, 3.59; 95% CI, 2.55-4.87; \( P = .001 \)), and errors on both medical (period 1 rate, 3.18; 95% CI, 2.45-4.05; period 2 and 3 rate,
Discussion | We found that implementation of a web-based handoff tool and training for health care professionals was associated with a significant reduction in rates of medical errors, driven largely by a reduction in errors attributable to communication failure and errors that occurred during end-of-shift handoffs. It is possible that the tool was more adept at improving end-of-shift handoffs, although it is also plausible that our study was underpowered to examine end-of-rotation handoffs, supported by the trend toward reduced errors observed in that subgroup.

More important, the reduction in rates of medical errors remained significant in the time-matched analysis (periods 1 vs 3), accounting for potential effects of resident experience. In addition, we saw a stepwise reduction in rates of errors on general medicine services, suggesting that regionalization between periods 2 and 3 had an additive or synergistic effect, supported by the fact that this reduction was not replicated on surgical services. As noted in the Figure, regionalization included dedicated time for handoffs. These results add to existing literature, which has focused mainly on the connection between poor-quality handoffs and medical errors, or evaluating the effects of interventions in limited patient populations with variable use of information technology tools.

Our findings are subject to several limitations. As this was a single-site study, our findings may not be generalizable to other institutions. However, the components of the handoff tool are easily adaptable to other sites, including those that use vendor electronic health records. In addition, we are not able to separate the effect of the handoff tool from that of training for health care professionals.

Conclusions | Our findings suggest that implementation of a web-based handoff tool and training for health care professionals is associated with fewer medical errors, particularly those owing to communication failures. In addition, our intervention appeared synergistic (or additive) with concurrent care team regionalization, suggesting effectiveness in a real-world context.

Stephanie K. Mueller, MD, MPH
Catherine Yoon, MS
Jeffrey L. Schnipper, MD, MPH

Author Affiliations: Division of General Internal Medicine, Brigham and Women’s Hospital, Boston, Massachusetts (Mueller, Yoon, Schnipper); Harvard Medical School, Boston, Massachusetts (Mueller, Schnipper).

Corresponding Author: Stephanie Mueller, MD, MPH, Division of General Internal Medicine, Brigham and Women’s Hospital, 1620 Tremont St, Roxbury, MA 02120 (smueller1@partners.org).

Published Online: August 1, 2016. doi:10.1001/jamainternmed.2016.4258.

Author Contributions: Dr Mueller had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Mueller and Schnipper.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Mueller.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Mueller, Yoon.

Administrative, technical, or material support: Mueller.

Study supervision: Schnipper.

Conflict of Interest Disclosures: Dr Schnipper reported receiving grant funding from Sanofi Aventis for an investigator-initiated study to design and evaluate an intensive discharge and follow-up intervention in patients with diabetes. No other disclosures were reported.

Funding/Support: This research was supported by funds within the Department of Medicine, Brigham and Women’s Hospital.

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


Invited Commentary
The Search for Better Patient Handoff Tools
Transfer of care of patients from one physician to another—referred to as the handoff—is a period laden with vulnerabilities. Miscommunication during handoffs is one of the most common preventable sources of adverse events in the hospital. Since 2003, when resident-duty-hour restrictions were implemented in the United States, handoffs have become more common. Efforts to make handoffs uniform, usually involving standardized sign-outs, have improved safety and have become widely accepted.

Many web-based handoff tools also have been created and are increasingly being used. Despite their popularity, to our knowledge, few studies have specifically evaluated these tools and rigorously assessed their effect on hospital workflow and patient care.

Related article page 1400

Received: May 16, 2016. Revised: June 29, 2016. Accepted: June 30, 2016. Published Online: August 1, 2016. doi:10.1001/jamainternmed.2016.4258.
they found that implementation of this web-based handoff tool led to reductions in rates of medical errors related to communication failures during end-of-shift handoffs.

Although the findings are noteworthy, the results of this study may be confounded. Physicians participated in handoff and communication skills workshops during the implementation period, and these workshops—rather than the handoff tool itself—may have led to the decrease in rates of errors. However, other studies of written and electronic handoff tools have had similar designs. For example, the I-PASS (Illness severity, Patient summary, Action list, Situation awareness and contingency plans, and Synthesis by receiver) study also included handoff and communication skills workshops and instituted a handoff bundle based on the I-PASS mnemonic to standardize the verbal and written sign-out. Thus, the combined effect of bundled interventions may be important.

In the study by Mueller et al, the handoff tool was tightly integrated into the electronic medical record, allowing for autoupdate of demographic information, resuscitation preferences, and allergies, as well as automatic updating with progress notes. The updated fields included templates for key pieces of clinical information thought to be essential for high-quality information exchange at the time of patient handoff. In contrast, prior studies provided little information on the specifics of the sign-out tools and the key features that may have led to their success. In the I-PASS study, there was a basic format for the tool based on the mnemonic, and the handoff tool was built into the electronic medical record programs (at 7 sites) or word processing programs (at 2 sites). However, it is unclear whether these tools were integrated with the electronic medical record so that components, such as medications, could be updated automatically, or whether daily manual revision by physicians was required. It is also unclear if the tool included other components that are commonly part of written sign-outs, such as the patient’s resuscitation preferences, medications, allergies, and notable results of physical examinations. Further studies should compare the effectiveness of web-based handoff tools, critically assessing their features and functionality. Outcome measures should assess whether these tools have an effect on mortality, rates of adverse events, and length of stay, as well as physician satisfaction, efficiency, and communication errors.

It seems unlikely that any one handoff tool will fit all hospital settings perfectly. Hospital services vary and may require the flexibility to include unique components during sign-out. Furthermore, hospitals use different electronic health record systems, which may influence each tool’s functionality. However, certain key features of handoff tools may be important for success. For example, autoupdate of core fields from the electronic medical record is likely to improve efficiency and satisfaction, as well as prevent the communication of misleading or erroneous information (including medications, diagnoses, and resuscitation preferences).

As hospital care is increasingly shift based, a clear and efficient handoff process is vital. The study by Mueller et al shows how web-based handoff tools may improve hospital workflow and patient safety, but only if they are carefully built and integrated into existing systems.

Adam J. Schoenfeld, MD
Robert M. Wachter, MD

**Comments & Response**

**Appropriate Perspective and Context for Newly Approved Medications, Including Flibanserin**

To the Editor In a meta-analysis of data on flibanserin in a recent issue of *JAMA Internal Medicine*, Jaspers et al concluded that the drug had minimal efficacy and significant risk. The related editorial by Woloshin and Schwartz characterized flibanserin as a “marginally effective drug [with] substantial...uncertainty about its dangers.” While we welcome such analyses on novel therapies, we believe that the interpretation of the data and regulatory history struck a heavy-handed tone with a disproportionate emphasis on the risks. As sexual medicine clinicians with decades of experience, we believe that both the meta-analysis and editorial lacked proper understanding of the condition of hypoactive sexual desire disorder (HSDD) and did little to clarify the efficacy of flibanserin. While sexually satisfying events were a coprimary end point in all of the pivotal trials due to regulatory carryover from trials assessing erectile dysfunction treatments in men, it must be emphasized that sexual activity is entirely unrelated to the

**Author Affiliations:** Department of Medicine, University of California, San Francisco.

**Corresponding Author:** Adam J. Schoenfeld, MD, Department of Medicine, University of California, San Francisco, 3333 California St, Ste 265, PO Box 0936, San Francisco, CA 94118 (adam.schoenfeld@ucsf.edu).

**Published Online:** August 1, 2016. doi:10.1001/jamainternmed.2016.4258.