

## Improving Electronic Patient Handoff in an Orthopaedic Residency using the Listrunner® Application

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### ABSTRACT

**Introduction.** Miscommunication during shift change and other handoff events is a common source of malpractice claims and patient-care errors. An efficient patient handoff system is imperative to prevent miscommunication. Owing to limitations with our current handoff system and to an ever-increasing reliance on electronic health information, our residency program sought to modernize our handoff method.

**Methods.** To improve handoff communication, the HIPAA-compliant application Listrunner® was adopted. Members of the orthopaedic trauma team were oriented to the new application. Change-of-shift patient handoff was transitioned from the current email system to Listrunner®. After three months of using the new application, a web-based questionnaire was administered to all members of the care team to assess their experiences, including perceived benefits and limitations of the Listrunner® application.

**Results.** Seventeen orthopaedic resident physicians and three orthopaedic trauma attending physicians completed the survey. While almost half of the respondents were satisfied using email as a checkout tool, more than half of study participants indicated that it lacked security and several users believed there was a need for improvement. Most indicated that Listrunner® was easy to use, improved clinical efficiency, and improved patient care and safety. Seventeen of 20 respondents reported that they would like to continue using Listrunner® as a checkout tool.

**Conclusions.** The Listrunner® application was adopted quickly by our orthopaedic trauma team, whose members opined that the application increased the efficiency and accuracy of handoff when compared to the previous secure email system. *Kans J Med* 2022;15:97-100

### INTRODUCTION

Inaccurate communication at shift change continues to be identified as a common source of medical errors. Errors in communication account for 60 - 70% of all sentinel events within a hospital.<sup>1</sup> Furthermore, miscommunication is a leading cause of malpractice claims.<sup>2</sup>

Since many providers are responsible for the care of a single patient, having an efficient patient handoff system to communicate patient information is vital. It is the opinion of these authors that an effective handoff system should contain accurate and up-to-date information

about a patient's current condition, care plan, and any anticipated changes in clinical status. With increasing reliance on electronic information sharing, the need for secure electronic patient information sharing has become a top demand among healthcare providers.

Despite their shortcomings, which include user distraction, potential transmission of patient protected health information on unsecure networks and risk of misusing confidential information, smartphone use for patient care is increasing. A recent survey conducted in France documented that approximately 75 - 95% of medical students and residents are using their personal smartphones for clinical work, commonly to utilize applications (apps) or to communicate with the care team via email, text messages, or phone calls.<sup>3</sup> Another survey of American neurology trainees and attending physicians regarding their cell phone use in the clinical setting demonstrated that both groups used their personal smartphones for their physical exams, clinical work, and communications, with the majority of respondents reporting their smartphones as "very useful" or "essential" for patient care.<sup>4</sup> In a systematic review, Gurses et al.<sup>5</sup> showed that information tools, which include electronic devices such as personal digital assistants, wireless tablets and mobile computers, improved situational awareness of multidisciplinary care providers, efficiency of multidisciplinary rounds, and length of hospital stay.

To date, mobile technologies have been used mainly to support coordination of care through text messaging and email among care team members in an informal way, but their use in structured rounding and handoff processes has been limited. However, using computerized rounding and patient handoff tools have been shown to increase efficiency within inpatient medical services.<sup>6</sup> Furthermore, there are stand-alone applications serving as electronic handoff tools and mobile applications associated directly with hospital electronic medical records (EMRs).

In our orthopaedic residency program, a secure email system has been the primary tool used for patient handoff. This consists of a daily email, sent at 0500, providing a summary list of patients who were seen overnight. There are many aspects of the email system that make it less than ideal for patient handoff. Lack of real-time viewing or updating and no capability to input clinical photographs or patient radiographs are two reasons that our program sought a digital upgrade. The objective of this quality improvement (QI) study was to improve communication among care team members using an application, compliant with the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule, which would allow electronic patient handoffs of overnight patient care at two tertiary health care centers.<sup>7</sup>

### METHODS

This intervention was performed within the University of Kansas School of Medicine-Wichita orthopaedic surgery residency program, where trauma call at two tertiary care centers was covered by residents on the orthopaedic trauma surgery service. In an effort to improve accuracy and provide real-time updates to attending staff, residents, and other orthopaedic trauma healthcare team members, the HIPAA-compliant application Listrunner® was adopted. The project design was adapted from a publication on the use of mobile devices for inpatient rounding and handoffs.<sup>8</sup>

During the study period, handoff communication was transitioned from a secure email system to the Listrunner® application. The application has patient list features that are customizable to the preferences of the attending staff. This app can be installed on a mobile device or accessed through the Listrunner® website. Training of the on-call junior residents on proper use of the app was provided by upper-level residents and attending staff members. At our institution, like many other residency programs, junior residents were responsible for managing the orthopaedic trauma service overnight.

After appropriate training and standardized implementation of the Listrunner® app, the overnight junior residents assumed the responsibility of adding patients to predetermined lists that reflected the reason for referral to our orthopaedic service: surgery add-ons, admits, consults, and phone calls. The application allowed for accurate short-form text documentation including medical record number, date of birth, age, history of present illness, discussion, clinical treatment and planning, imaging, clinical photographs, and a to-do section for pending tasks. Team members had the option to allow notifications when a new patient was added to a list, which allowed real-time patient care updates. The application was used only for handoff communication and was not linked formally to the hospital EMR. Patient lists were cleared or updated daily after review by the daytime trauma team.

After three months of consistent use, a web-based questionnaire was created to evaluate the Listrunner® application compared to the previous email system (Appendix available online only at journals.ku.edu/kjm). Specifically, usage patterns, user experiences, and perceived benefits and drawbacks to the Listrunner® app were assessed. The survey consisted of 23 multiple choice items and 4 free-response items. The multiple-choice questions utilized the Likert scale. A draft or pilot survey was used to assess survey validity and readability. After minor modifications, the final survey was distributed via email to all members of the orthopaedic trauma service, including attending physicians, resident physicians, advanced practitioners, nurses, and office scheduling personnel.

Study data were collected and managed using REDCap® (Research Electronic Data Capture) electronic data capture tools hosted at University of Kansas Medical Center.<sup>9,10</sup> REDCap® is a secure, web-based software platform designed to support data capture for research studies by providing 1) an intuitive interface for validated data capture; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for data integration and interoperability with external sources. In an effort to report our findings in a standard fashion, the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) guided the preparation of this manuscript.<sup>11</sup>

**RESULTS**

Our inpatient orthopaedic trauma services at two level one trauma centers began using the Listrunner® patient handoff application in September 2020. We used the application consistently for approximately three months before conducting a one-time survey to compare the Listrunner® application to the previously used email handoff system and to examine user experience, satisfaction, and suggestions for improvement regarding the use of Listrunner®.

The survey was offered to 31 orthopaedic trauma team members including medical assistants, nurses, advanced practitioners, resident physicians, and attending physicians. The initial email solicitation was sent on January 26, 2021. A reminder email was sent on February 18, 2021. Twenty-six team members began the survey and 23 members completed the survey. Only completed surveys of individuals who identified as Listrunner® users were compiled for analysis, with incomplete surveys and non-users being excluded. The survey took an average of 17 minutes to complete.

User characteristics are outlined in Table 1. Seventeen of the 20 residents in our program completed the survey. Sixteen described themselves as continued users of the application and one was self-described as an episodic user. Three of four attending physicians completed the survey. One advanced practitioner, one office staff member, and one nurse also completed the survey. Users universally reported accessing the application using the mobile app, with no respondents reporting routine use of the desktop website.

**Table 1. Characteristics of users studied.**

Characteristics	Respondents
<i>How would you describe your role?</i>	
Attending physician	3
Resident physician	17
APRN <sup>1</sup> /PA <sup>2</sup>	1
Nurse	1
Office staff/MA <sup>3</sup>	1
Student/other	0
Total respondents	23
<i>Describe your experience using Listrunner®</i>	
Continued user <sup>4</sup>	22
Episodic user <sup>5</sup>	1
Total respondents	23
<i>Which version of the checkout tool do you commonly use?</i>	
Webpage	0
Mobile app	23
Total respondents	23

<sup>1</sup>Advanced Practice Registered Nurse

<sup>2</sup>Physician Assistant

<sup>3</sup>Medical Assistant

<sup>4</sup>Application use for eight weeks or longer

<sup>5</sup>Stopped using application within eight weeks

Multiple choice responses regarding the email system are characterized in Figure 1. About half of respondents agreed or strongly agreed that they were satisfied using the email system as a checkout tool and most felt that the system was efficient and easy to use. However, 10 of the 23 (43.5%) respondents indicated that the email system was inadequate or in need of improvements and 14 respondents (60.9%) indicated that the email system lacked security.

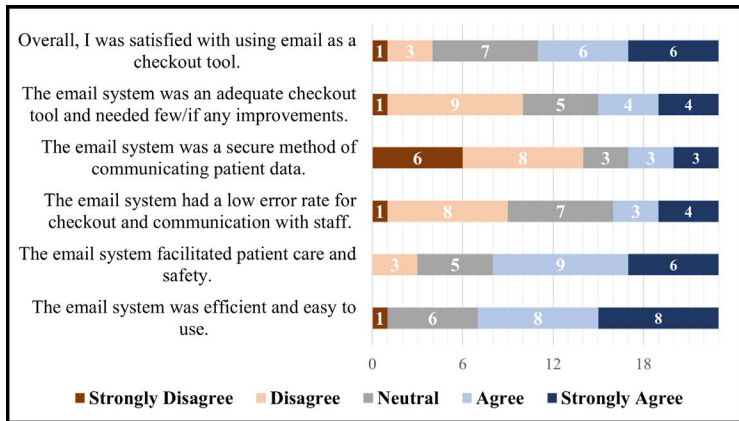


Figure 1. User responses regarding the email system.

Multiple choice responses regarding the Listrunner® application are characterized in Figure 2. The majority of users agreed or strongly agreed that the Listrunner® application was easy to use, improved clinical efficiency, and improved patient care and safety. Eighteen of 23 respondents found the application to be more useful as they became more familiar with it. Fifteen respondents disagreed or strongly disagreed that Listrunner® had significant drawbacks that should prevent its continued use. Seventeen respondents reported that they would like to continue using Listrunner® as a checkout tool.

Free response questions were included in the survey to determine specific likes, dislikes, and suggestions for improvement regarding the email system and the Listrunner® application. Specific likes regarding the email system included the brevity, simplicity, and format of the system. Users found it helpful having all the checkout information in one document, which decreased the amount of time needed to review the entire shift checkout. One specific dislike regarding the email system included a lack of perceived security, specifically when some users were not university employees and did not have access secure email accounts and used their personal email accounts. Other dislikes regarding the email system included difficulty in finding patients from previous shift checkouts, lack of functionality, and a lack of live updates.

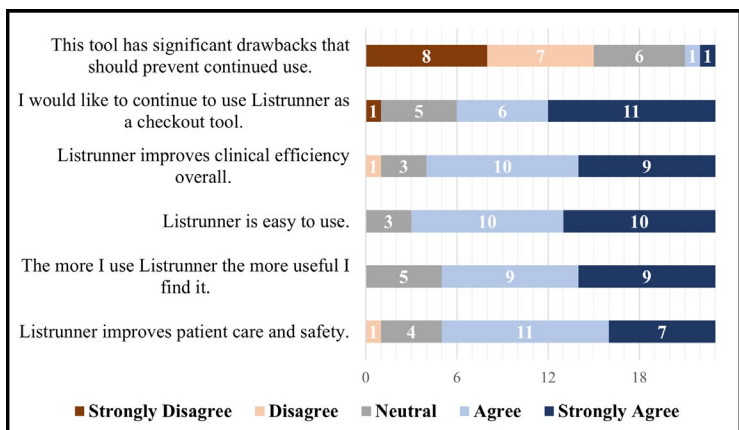


Figure 2. User responses regarding the Listrunner® application.

There were multiple aspects of the Listrunner® application that users liked, including real-time updates, added functionality (e.g., uploading radiographic images and clinical photographs, searching lists for patients, and to do lists), application security, ease of use, and easier coordination of clinical follow up. There were also aspects of the new system that some users disliked, including longer time spent to read through the entire handoff, having to sign into the application multiple times on a single shift, more time spent to enter patient information, and the need to update patient lists continually.

There were numerous suggestions from users to improve the new Listrunner® system. Many commented on the inability to upload groups of pictures at one time. The application required that the user upload one picture at a time, which added significantly more time over the course of a shift, particularly if it was necessary to upload multiple clinical pictures and/or radiographs per patient. Other suggestions for improvement included more consistent daily updating of patient lists and adding indicator tabs to highlight new patients and new tasks added.

Other respondents suggested that use of the application should be standardized on the two trauma services. At one hospital, in addition to being used as a handoff tool, the application also was used as a running inpatient list. At the other hospital, the orthopaedic trauma service utilized the application only as a handoff tool, using the hospital EMR for a running inpatient list. Standardized use of the app on both services would, in the opinion of some users, decrease potential communication errors and make it easier on the resident responsible for entering patients into the application.

### DISCUSSION

This QI project showed that the Listrunner® patient handoff application was well received by our orthopaedic residency program and, in the opinion of the users, increased the accuracy and efficiency of patient handoff when compared to a secure email system. A strength of this study was that it clearly showed there was a viable electronic handoff system that can be more efficient and more interactive than a simple email system. Similar to the study on which our QI project was based<sup>8</sup>, the results showed that a handoff tool can be adopted quickly, lead to improved patient care, and increase the accuracy of patient handoff. Another unexpected benefit that this project had on our trauma service was improving the efficiency of follow-up scheduling by the office staff, which was an unanticipated benefit of the Listrunner® application.

There were significant limitations to our study. Our small sample size decreased the overall power of the statistical analysis. There were three team members who did not complete the survey, which further limited our sample size. Another weakness of this study was enforcement of the use of the Listrunner® application, and while all handoffs were done using the Listrunner® application, some users may not have been utilizing it throughout their shift. Due to the unique nature of our call system requiring the coverage of two level one trauma centers, the results may not be generalizable to other orthopaedic trauma services. Future QI projects regarding patient handoff tools should include not only other medical and surgical specialties at our institution, but also orthopaedic trauma services at other institutions. In addition to expanding the study to include a more specialties and services, the methodology of future studies should include objective measures of improved efficiency

and patient care. These could include time spent by the on-call resident updating the handoff tool or email, as well as safety outcomes resulting from any miscommunication.

This project partly was inspired by the COVID-19 pandemic, during which the need for an accurate electronic patient handoff system to replace an in-person meeting became a top priority for our orthopaedic trauma service. Now, more familiar in-person interactions and verbal communication has resumed as the primary checkout modality. However, having a real-time, electronic handoff system that was convenient for trauma team members to use remains desirable.

At the time the application was adopted, Listrunner<sup>®</sup> was a free application. Users were able to download and use the program without a subscription or annual fee. After this survey was completed, Listrunner<sup>®</sup> notified users that the program would no longer be offered free of charge as of June 1, 2021. The app requires an organizational-based contract requiring an initial set-up fee of \$5,000 and an ongoing cost of \$25 per user per month. As our residency program did not have the budgetary means to enter into a contract with Listrunner<sup>®</sup>, the application was abandoned, and the residency program returned to using secure email for patient handoff.

At this time, the orthopaedic residency program had no plans to purchase a subscription for the Listrunner<sup>®</sup> application. Our residency program continued to search for a cost-effective, efficient, and secure alternative to our current secure email system. Given that our two trauma centers use different EMRs, a secure mobile application, separate from a specific hospital EMR, would be an ideal solution for an efficient electronic patient handoff system.

## REFERENCES

- <sup>1</sup> Murphy JG, Dunn WF. Medical errors and poor communication. *Chest* 2010; 138(6):1292-1293. PMID: 21138880.
- <sup>2</sup> CRICO Strategies. Malpractice Risks in Communication Failures: 2015 Annual Benchmarking Report. 2015. <https://www.rmfi.harvard.edu/Malpractice-Data/Annual-Benchmark-Reports/Risks-in-Communication-Failures>. Accessed September 28, 2021.
- <sup>3</sup> Bibault JE, Leroy T, Blanchard P, et al. Mobile technology and social media in the clinical practice of young radiation oncologists: Results of a comprehensive nationwide cross-sectional study. *Int J Radiat Oncol Biol Phys* 2014; 90(1):231-237. PMID: 24986747.
- <sup>4</sup> Zeiger W, DeBoer S, Probasco J. Patterns and perceptions of smartphone use among academic neurologists in the United States: Questionnaire survey. *JMIR Mhealth Uhealth* 2020; 8(12):e22792. PMID: 33361053.
- <sup>5</sup> Gurses AP, Xiao Y. A systematic review of the literature on multidisciplinary rounds to design information technology. *J Am Med Inform Assoc* 2006; 13(3):267-276. PMID: 16501176.
- <sup>6</sup> Van Eaton EG, McDonough K, Lober WB, Johnson EA, Pellegrini CA, Horvath KD. Safety of using a computerized rounding and sign-out system to reduce resident duty hours. *Acad Med* 2010; 85(7):1189-1195. PMID: 20592514.
- <sup>7</sup> U.S. Government Printing Office. Public Law 104-191. Health Insurance Portability and Accountability Act of 1996. August 21, 1996. <https://www.govinfo.gov/content/pkg/PLAW-104publ191/pdf/PLAW-104publ191.pdf>. Accessed December 16, 2021.
- <sup>8</sup> Motulsky A, Wong J, Cordeau JP, Pomalaza J, Barkun J, Tamblyn R. Using mobile devices for inpatient rounding and handoffs: An innovative application developed and rapidly adopted by clinicians in a pediatric hospital. *J Am Med Inform Assoc* 2017; 24(e1):e69-e78. PMID: 27554824.
- <sup>9</sup> Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) - A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009; 42(2):377-381. PMID: 18929686.
- <sup>10</sup> Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: Building an international community of software platform partners. *J Biomed Inform* 2019; 95:103208. PMID: 31078660.

<sup>11</sup> Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence): Revised publication guidelines from a detailed consensus process. *BMJ Qual Saf* 2016; 25(12):986-992. PMID: 26369893.

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