"Workin' on Our Night Moves": How Residents Prepare for Shift Handoffs

Laura G. Militello, MA; Nicholas A. Rattray, PhD; Mindy E. Flanagan, PhD; Zamal Franks, BS; Shakaib Rehman, MD; Howard S. Gordon, MD; Paul Barach, MD, MPH; Richard M. Frankel, PhD

Background: Poor-quality handoffs have been associated with serious patient consequences. Researchers and educators have answered the call with efforts to increase system safety and resilience by supporting handoffs using increased communication standardization. The focus on strategies for formalizing the content and delivery of patient handoffs has considerable intuitive appeal; however, broader conceptual framing is required to both improve the process and develop and implement effective measures of handoff quality.

Methods: Cognitive task interviews were conducted with internal medicine and surgery residents at three geographically diverse US Department of Veterans Affairs medical centers. Thirty-five residents participated in semistructured interviews using a recent handoff as a prompt for in-depth discussion of goals, strategies, and information needs. Transcribed interview data were analyzed using thematic analysis.

Results: Six cognitive tasks emerged during handoff preparation: (1) communicating status and care plan for each patient; (2) specifying tasks for the incoming night shift; (3) anticipating questions and problems likely to arise during the night shift; (4) streamlining patient care task load for the incoming resident; (5) prioritizing problems by acuity across the patient census, and (6) ensuring accurate and current documentation.

Conclusion: Our study advances the understanding of the influence of the cognitive tasks residents engage in as they prepare to hand off patients from day shift to night shift. Cognitive preparation for the handoff includes activities critical to effective coordination yet easily overlooked because they are not readily observable. The cognitive activities identified point to strategies for cognitive support via improved technology, organizational interventions, and enhanced training.

Poor-quality handoffs have been associated with serious consequences, including increased hospital readmissions, complications, adverse events, unnecessary tests, and diagnostic delays.[1–3] The Joint Commission estimated that 80% of serious medical errors involve miscommunication between caregivers during patient handoffs.[4] The Accreditation Council for Graduate Medical Education mandated, in response to this concern, common program requirements to "ensure and monitor effective, structured handover processes to facilitate both continuity of care and patient safety."[5(p. 13)]

Researchers and educators have answered the call with efforts to increase system safety by supporting handoffs using increased standardization.[6] Generally, these attempts incorporate some form of a mnemonic (for example, I-PASS, SBAR), checklist, or decision aid representing the classes of information that should be included in the handoff and communication strategies. Indeed, a recent literature review uncovered 57 articles offering 36 different mnemonics, with the majority unvalidated.[7,8] The I-PASS Handoff Curriculum is perhaps the most well-known and most comprehensive such program, incorporating organizational planning and support, as well as a culture change campaign.[9,10] The I-PASS

program has shown promise,[9,10] but many others have failed to make an impact on the effectiveness of handoffs. In fact, a contemporaneous literature review concluded that little evidence indicates that standardization of handoffs leads to sustainable patient improvements.[11] A more recent meta-analysis suggests that introducing a standardized handoff protocol may increase the information passed and improve outcomes but also tends to increase the rates of omission errors and time required to complete handoffs.[12] The focus on strategies for formalizing the content and delivery of patient handoffs has considerable intuitive appeal; however, broader conceptual framing is required to both improve the process and develop effective measures of handoff quality.[13]

In this study, we focused on preparation for the end-of-shift transition from the primary team (day shift) to the cross-cover resident (night shift) (Figure 1). Residents on the day shift are actively engaged in planning, making treatment decisions, monitoring, and adjusting care plans for each patient on their panel. Night shift residents (cross cover), on the other hand, are usually responsible for a larger number of patients and are generally charged with carrying out existing care plans and addressing emergencies such as patient deterioration. Night shift residents are less actively engaged in choosing new treatment options and creating care plans and are not likely to have a deep familiarity with the patients under their care.[14] This fundamental difference in roles and responsibilities shapes the way that the outgoing day shift
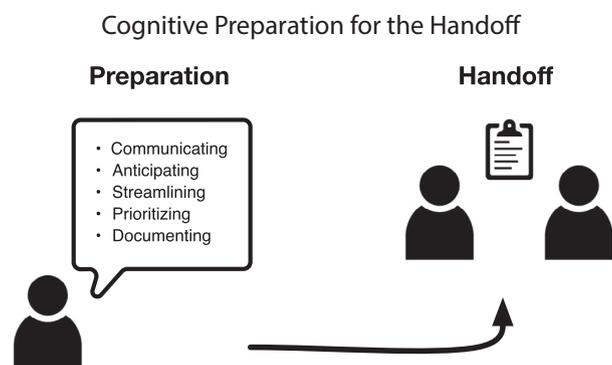
Cognitive Preparation for the Handoff

Figure 1: This study uses qualitative methods to explore the cognitive challenges outgoing day shift residents must manage in order to conduct an effective handoff for the incoming night shift resident.

residents prepare for and conduct the patient handoff with incoming night shift residents.

METHODS

We conducted a qualitative study using cognitive task analysis (CTA) to explore how residents managed cognitive demands associated with anticipating and developing expectations as they prepared for handoffs.[15]

Setting and Participants

Data were collected at three geographically diverse US Department of Veterans Affairs (VA) Medical Centers (VAMCs). We relied on a convenience sample, using an adaptation of key informant snowball sampling to identify participants.[16–18] Working with the three site principal investigators, we used four strategies for identifying key informants from the departments of medicine and surgery: (1) chief residents were asked to nominate "residents who you believe give outstanding end-of-shift handoffs of care/sign-outs"; (2) residents were asked to nominate peers during staff meetings using the same selection criteria; (3) residents were approached after handoffs for opportunistic interviews; and (4) each resident, after an initial set of participants was recruited, was asked to recommend other residents using the same criteria. We set recruiting goals at each site based on the pool of residents available and continued until recruitment goals were met.

The notion of interviewing key informants was derived originally from anthropology and includes typically "local experts" who are particularly knowledgeable or insightful about a phenomenon of interest.[19] Our intent was to obtain a diversity of "insider" perspectives of the handoff process. Resident participants received a $100 gift card. Ethics approval was obtained from the Indiana University Institutional Review Board and VAMC R&D Human Subjects Board.

Data Collection

One-hour semistructured individual interviews were conducted with residents working on medicine wards and surgical services, consisting of a tailored CTA Task Diagram and cognitive probes.[15] CTA has been used to explore complex decision making in family practice medicine,[20] endoscopic surgery,[21] neonatal intensive care nursing,[22] and sepsis recognition in emergency departments.[23] The interviews were conducted in a quiet location in the hospital. Participants were asked to recall the last patient handoff they conducted and describe the four to five major steps in how they prepared for and conducted the handoff. Probes were used to explore cues, goals, strategies, and information needs during each step of the transfer as well as to explore the use of handoff tools and their training/experience. The interview methods were designed to elicit difficult-to-articulate cognitive strategies that guide the decisions of experienced practitioners. Note that our intent was not to quantify or assess the cognitive load, but to qualitatively characterize the cognitive challenges that residents must manage.[24,25]

Data collection occurred over a 15-month period, from April 2015 through June 2016. Study participants were contacted and consented prior to participating in an interview. The interviews were audiotaped, professionally transcribed, and checked for accuracy.

Data Analysis

The interview data were analyzed using a thematic analysis—a qualitative research approach.[26] Three coders [N.A.R., M.E.F., L.G.M.] independently reviewed a sample of interview transcripts. Each coder highlighted meaningful portions of the text that were relevant to the project goals and assigned them provisional code names using open coding.[26] In building the inventory of codes, portions of the text and provisional codes were compared and differences reconciled in a series of iterative consensus-building meetings until thematic saturation was reached (that is, when no new codes emerged).[27] We also conducted a confirmability audit by matching code definitions with transcript case examples and discussing each to ensure alignment.

The interviews were entered into NVivo 10 (QSR International [Americas] Inc., Burlington, Massachusetts). For this analysis, three analysts independently reviewed the data within the *preparation* and *handoff tool use* categories by grouping related data excerpts, identifying themes and insights, and arriving at a consensus on the key themes and findings.

RESULTS

A total of 35 physician interviews were analyzed, representing three participating sites. See Table 1 for a breakdown of participants by site.

Our analysis revealed six key cognitive tasks, or "themes," that residents engaged in while preparing for end-of-shift handoffs, as well as a description of external resources used to support end-of-shift handoffs. Each is described in turn.

Table 1. Study Participants by Site

	PGY-1		PGY-2		PGY-3		
	Medical	Surgical	Medical	Surgical	Medical	Surgical	Total
Site 1	0	0	7	1	1	0	9
Site 2	12	2	1	2	0	1	18
Site 3	8	0	0	0	0	0	8
Total	20	2	8	3	1	1	35

PGY, postgraduate year.

Theme 1: Communicating Status and Care Plan for Each Patient

Residents emphasized that there was a balance between providing all the information the night shift resident might need while making a deliberate effort to not overwhelm him or her with too much information. One resident explained the dilemma as follows: "We don't want there to be a lot of information that is not relevant to the current patient course because it can be easy to get bogged down." Others used phrases such as "complete and concise" or "pertinent positives and negatives." One resident described taking the perspective of the incoming resident: "I like to think about, you know, 'If I got called on this patient in the middle of the night, what would I want to know about them?'" Many residents described the importance of including a one-to-two-line narrative summary about each patient. They also described selectively including historical information, current status, anticipated care needs and problems, plans and goals for the patient, and logistics (for example, contact information for providers involved in a patient's care), depending on context. In some cases, nonmedical information becomes an important part of the handoff; in other cases less so. One resident offered an example of a patient with a history of substance abuse: "Let's say someone has particular substance abuse issues and you're trying limit the number of narcotics they get [if they request more], telling the on-call person if there is a plan." Other relevant information about patients may include family consent, religious beliefs that influence care decisions, or relevant personality characteristics.

Theme 2: Specifying Tasks for the Incoming Night Shift

Day shift residents typically create a "to-do" list containing items to be completed by the overnight shift resident. Day shift residents reported differentiating between "urgent" and "deferred" actions on the list. One resident highlighted the need to exclude problems that have a low clinical urgency. Some referred to taking care not to "dilute" the list with unnecessary tasks; one emphasized that it is "not a list of what would be 'nice' but what <u>must</u> be done." Key details to incorporate included such things as indicating specific timing for tasks (for example, "Look at troponins every 6 hours."), expected test results, and specific instructions (for example, "Check their magnesium level and replace it if it's low.").

One resident remarked on the importance of writing "NTD" or "nothing to do" next to the patient's name to explicitly account for each patient and allay the incoming resident's anxiety.

Theme 3: Anticipating Questions and Problems Likely to Arise During the Night Shift

Residents placed emphasis on anticipating key problems that could arise during the night shift. One resident noted, "When I'm thinking about the active medical issue, it's what kind of box do I want to frame for the night float so . . . when they get called . . . they know immediately to start thinking . . . about certain issues that are most active." Based on these possibilities, residents defined "contingency plans." Contingency plans tended to take the form "If patient A experiences X, then do Y" and were based on patient care trajectories, such as the following: "If the sodium hits 135, then start this fluid. If the potassium reaches over 6, then give them this." One resident stressed the importance of making the treatment rationale explicit: "It's always a good thing to let the night float know if things do change and our current plan fails, what were the next steps we were thinking about . . . so he or she has some guidance about decision making at night."

One resident described the challenge of anticipating potential problems in the following way: "It's hard to make a perfect sign-out because it's hard to predict exactly what could potentially happen. . ..." Another said that trainees early in their internship learning process might struggle and cautioned that they ". . . may not yet know what to anticipate and, therefore, can't offer that guidance yet."

Theme 4: Streamlining Patient Care Task Load for the Incoming Resident

Residents, in preparing for the handoff, described a goal of reducing the number of decisions that the night resident would "inherit." Day residents narrowed the scope of work by completing patient care tasks (for example, checking test results, ordering tests, completing chart documentation), and "tucking in" patients by adjusting orders to reduce the number of nursing calls and managing active patient issues. Residents aimed to ensure that orders for medications or tests were complete and entered prior to the handoff. One resident described adjusting medication orders to reduce questions

from nursing for the night resident: "I also go ahead and make sure I have a couple of the basic medications that we call prn or as needed . . . some medication that the nurse can give if for some reason the pressure is elevated."

Theme 5: Prioritizing Problems by Acuity Across the Patient Census

Residents described identifying which patients might require the most vigilance and active interventions overnight, and providing a more detailed presentation of those patients to the incoming resident. Residents used the terms *sick* and *not sick* to signal more emphatically the acuity of a patient's condition. The term *sick* referred to patients who could decompensate during the next shift. One resident described a typical sick patient: "Sick patients are the ones that are going to require more care and that I'm a little more nervous about that I think could decompensate fairly quickly. They're the ones that actually do have more acutely going on, or even if nothing acute is going on, they just have so many chronic things going on that it wouldn't take much to tip them [over]." The idea of prioritizing was described as helping a night or cross-cover resident triage patients and manage his or her attention and time more effectively.

Theme 6: Ensuring Accurate and Current Documentation

Participants reported making updates to patient records throughout the day, but more intensely prior to the handoff. These updates were described as important in preparing for the handoff and maintaining the salience of critical patient issues. During handoff preparation, residents described reviewing different portions of the electronic health record (EHR) and other sources of information to ensure that all documentation was current and accurate and represented the latest decisions on patient care. These sources included consultants' notes, nursing notes, "notes to self" written for the patient, vitals, medications, orders, test results, and treatment plans. Some residents reported verbal communication checks with other providers to ensure that the patient information was current and accurate. One resident emphasized that rapid changes in vital signs needed to be communicated to the incoming residents: "If . . . the last vitals 4 hours ago look okay, but then 2 hours ago they looked not so great, and now they look pretty bad, there is an obvious change there that may not be directly documented."

Additional External Resources Mentioned by Residents to Aid Handoffs

Residents described the EHR and the CAIRO handoff[28] tool as valuable resources in preparing for and conducting end-of-shift handoffs. Both provide cognitive support. The CAIRO handoff tool contains four fields for each patient: Patient Identifiers and Allergies, Active Medications, Active Problems, and To Do List (Figure 2). These fields are either automatically populated or include free-text boxes for residents to complete. Residents type in patient information or copy and paste information from the patient's EHR. One resident described these text fields as a memory cue for what to say during the verbal handoff. Residents reported that they found the VA's electronic-based handoff tool easy and quick to generate when preparing to give a handoff. One resident suggested that the VA handoff communication is less "cumbersome" as compared to non-VA facilities due to the CAIRO tool. At other hospitals, the residents perceived spending much more time creating a printed handoff form because they did not have a structured electronic-based handoff tool.

DISCUSSION AND RECOMMENDATIONS

Our findings suggest that resident physicians' cognitive preparation for the handoff plays a critical role in promoting system resilience. Residents attempt to reduce coordination errors and safely transfer responsibility for patients to their colleagues while anticipating the complex exchanges between individuals and across teams of clinical providers. We identified six important cognitive activities that occur during preparation for a day-to-night end-of-shift patient handoff. Although there have been calls for translating the concept of resilience to patient handoffs,[29] these six activities have largely been unexplored in the burgeoning literature on improving the reliability and quality of patient handoffs.

The six activities—(1) communicating status and care plan for each patient; (2) specifying tasks for the incoming night shift; (3) anticipating questions and problems likely to arise during the night shift; (4) streamlining patient care task load for the incoming resident; (5) prioritizing problems by acuity across the patient census; and (6) ensuring accurate and current documentation—are critical components of the complex cognitive landscape residents must navigate in order to ensure that their actions result in effective handoffs. The preparation strategies described are part of explicit contingency planning and resilience in the face of unexpected events. A critical component of this preparation is anticipating potential patient trajectories into the future. Outgoing residents must structure their thinking in such a way as to identify tasks yet to be completed and documented, have available key information about each eventuality logically organized, and be prepared to communicate these elements of the handoff in a succinct, coherent written and spoken narrative. Importantly, much of what transpires in the communication process is based on implicit assumptions about the nature and methods by which the information is shared. For example, although residents in this study talked about the cognitive strategy of handing off by acuity, direct observations of multiple handoffs revealed a range of approaches residents *actually deploy* but do not explicitly describe to the incoming resident (such as from handing off by room number, alphabetically, and by acuity).[30]

CAIRO Handoff Form Used in VA Health System

```
Name:                    Pager:                                                                    Run date:
Unit: IN GREEN PACT                     **CONFIDENTIAL** PHYSICIAN HAND-OFF REPORT                              Page: 1
                                               ****Active Meds****
NAME                             1. ACYCLOVIR 200MG CAP                    <<Problems>>              <<To Do List>>
ID                               2. CHLORTHALIDONE 25MG TAB
44 yr old Female                 3. CYCLOBENZAPRINE HCL 10MG TAB
Team:                            4. FLUOXETINE HCL 10MG CAP
                                 5. HYDROXYZINE HCL 10MG TAB
Attn:                            6. LATANOPROST 0.005% OPH SOLN
Days in Hospital:                7. LIDOCAINE 5% PATCH
Allergies                        8. MUPIROCIN 2% OINT
  CITALOPRAM (allergy)           9. OMEGPRAZOLE 2MG EC CAP
  CELEXA 10MG TAB (adv rxn)     10.TAPE, MICROPORE 1IN 3M #1530-1
                                11.TELFA PAD NON-ADHESIVE 3IN X 4IN
                                               ****Active Meds****
NAME                             1. ANASTROZOLE 1MG TAB                    <<Problems>>              <<To Do List>>
ID                               2. CALCIUM 600MG/VITAMIN D 400UNIT TAB
54 yr old Female                 3. CLINIDIEN 0.1MG/24HR PATCH
Team:                            4. CYCLOBENZAPRINE HCL 10MG TAB
                                 5. DOXYCYCLINE HYCLATE 100MG CAP/TAB
Attn:                            6. FLUTICASONE PROP 50MCG 120D NASAL INHL
Days in Hospital:                7. GABAPENTIN 300MG CAP
Allergies                        8. GLOVE NITRILE X-LRG PFREE NSTERL TX
  CLONIDINE (adv rxn)            9. LIDOCAINE 5% PATCH
                                10.OMEPRAZOLE 20MG EC CAP
                                11.ONDANSETRON HCL 4MG TAB
                                12.PROCHLORPERAZINE MALEATE 5MG TAB
                                13.TRAMADOL HCL 50MG TAB
                                14.TRIAMCINOLONE ACETONIDE 0.025% CREAM
                                15.VENLAFAXINE HCL 75MG 24HR SA CAP
                                               ****Active Meds****
NAME                             1. ACCU-CHEK AVIVA PLUS(GLUCOSE) TEST STRIP <<Problems>>            <<To Do List>>
ID                               2. ALBUTEROL 90MCG (CFC-F) 200D ORAL INHL
60 yr old Female                 3. BUPROPION HCL 150MG 12HR SA TAB
Team:                            4. FLUTICASONE PROPO 50MCG 120D NASAL INHL
                                 5. LOSARTAN 25MG TAB
Attn:                            6. METFORMIN HCL 500 MG 24HR SA TAB
Days in Hospital:
                                               ****Active Meds****
NAME                             1. ALBUTEROL 90MCG (CFC-F) 200D ORAL INHL  <<Problems>>            <<To Do List>>
ID                               2. ATORVASTATIN CALCIUM 80MG TAB
62 yr old Female                 3. AZITHROMYCIN 1% OPH SOLN
Team:                            4. BRIEF, PROTECTIVE EXTRA ABS MED ATTENDS
                                 5. BUDESONIDE 80/FORMOTER 4.5MCG 120D INH
Attn:                            6. BUPROPION HCL 300MG 24HR SA TAB
Days in Hospital:                7. BUSPIRONE HCL 10MG TAB
Allergies                        8. CHOLECALCIFEROL (VIT D3) 2,000UNIT TAB
  PENICILLIN (allergy)           9. DICLOFENAC NA 1% TOP GEL
  VIVELLE (allergy)             10.FISH OIL 100MG (500MG DHA/EPA) CAP
Diet: NO ORDER                  11.HYDROXYZINE HCL 10MG TAB
                                12.LEVOTHYROXINE NA (SYNTHROID) 0.1MG TAB
                                13.MELOXICAM 15MG TAB
                                14.ROPINIROLE HCL 2MG TAB
                                15.TIZANIDINE HCL 2MG TAB
                                16.TROSPIUM CL 20MG TAB
                                17. VENLAXINE HCL 75MG TAB
                                18. VITAMINE B COMPLEX W/B-12 TAB


Notice to Users: Text present on this prinout is a summary intended for use by staff as they come on duty and for quick reference.
The patient's health record must be consulted in cases when this summary information isinadquate for patient care.
```

Figure 2: The CAIRO tool provides a structured template for residents in preparing for handoffs, and a clinical artifact to aid the incoming resident. The cognitive requirements identified in this study suggest strategies for improving cognitive support features of the CAIRO Handoff Form. VA, US Department of Veterans Affairs.

Table 2. Examples of Strategies for Improving Information Technology to Support Cognitive Preparation for Handoffs

Cognitive Activities	Cognitive Requirements	IT Support
1. Complete open tasks	1.1. Review status and plan for each patient 1.2. Note incomplete tasks (for example, labs and tests not returned)	Provide visual cues for incomplete tasks in EHR
2. Ensure that documentation is up to date	2.1. Review note and update in EHR 2.2. Remember things not yet documented	Improve auto-populate from EHR feature (for example, include IV antibiotics, populate new patients)
3. Organize information	3.1. Determine what to include on handoff form, what to leave off—for each patient 3.2. Communicate status and plan succinctly and clearly	Improve formatting on handoff form (for example, include meaningful column headers, provide formatting tools)
4. Specify tasks	4.1. Determine what must be done overnight; what can wait 4.2. Create succinct and clear list	Allow formatting of "To Do List" on handoff form
5. Anticipate questions and problems	5.1. Assess current status and project into future for each patient 5.2. Articulate likely problems/events and preferred actions	Provide field for contingency plans
6. Prioritize across patient census	6.1. Identify patients that are at risk of decompensating 6.2. Determine which patients warrant focused attention during night shift 6.3. Communicate priorities	Provide standard notation for prioritizing patients

IT, information technology; EHR, electronic health record; IV, intravenous.

Our findings complement other research based on resilience engineering[31–33] highlighting underlying tensions that shape handoffs (for example, document everything vs. provide timely care),[29] invisible work required to maintain continuity across shifts,[34] and requirements for effective collaborative cross-checking during handoffs.[35] The cognitive activities identified here may represent strategies that can aid residents in making dynamic trade-offs as they flexibly adapt each handoff based on the number and acuity of their patients, time available, the setting in which the handoff occurs, and the recipient's perceived competencies. In addition, the findings point to residents' reliance on one another's tacit knowledge and on the communication tasks required to enact effective handoffs.

One strategy to support adaptive solutions by residents is the CAIRO handoff tool[28] used by participants in this study (Figure 2). The handoff form automatically populates key fields based on the most recent EHR–based information to ensure that relevant clinical information is accurate and current (Theme 6). This reduces the likelihood of data entry errors while simultaneously providing a list for both the outgoing and the incoming residents to share and review. The open text fields in the EHR form aid in organizing information such as clinical status and the care plan for each patient (Theme 1) and tasks and instructions for the night shift team (Theme 2).

The handoff tool can provide improved cognitive support by explicitly considering the cognitive requirements associated with these activities (Table 2). Specific recommendations for improving cognitive support using these technologies include providing visual cues in the EHR for labs and tests that have not been returned to reduce the memory load and anxiety on the resident as he or she completes open tasks and "tucks in" patients prior to handoff. Similarly, increasing the completeness of the data that are automatically populated would likely reduce cognitive load. Although the current system of auto-populated data is a step in the right direction, gaps such as missing medications and newly admitted patients create unnecessary cognitive load, and residents must notice which information is missing. Improving the format of the handoff tool by making it easier to spot missing information, to scan and locate key information, and to emphasize, de-emphasize, or group particular items could guide the work efforts of the outgoing resident in clearly communicating key information during the handoff. Providing a field for contingency plans would encourage both the outgoing and incoming residents to consider and discuss contingencies during the handoff. Introducing conventions for highlighting priority information would relieve each resident of having to improvise a strategy for communicating priorities about patients. These strategies focus on improving cognitive support for the outgoing resident as he or she prepares for the handoff.

Technology can support the cognitive requirements related to handoff preparation but may not be sufficient. For example, succinctly communicating the status and care plan for each

patient, specifying tasks for the incoming night shift, and anticipating questions and problems likely to arise during the night shift, all require focused thought. Some participants reported that 15 minutes (or even less) is often enough time to focus one's thoughts and complete the handoff preparation. However, interruptions during this period of time are routine, jeopardizing the quality of the enacted handoff. One study of high-acuity settings found that physicians failed to return to 18.5% of interrupted tasks.[36] Our data during this study (not reported) suggest that residents often do not have the uninterrupted time needed to adequately prepare for the handoff, resulting in poorly organized handoff communications. Strategies to increase resilience might include creating a dedicated preparation time free from interruptions prior to the scheduled handoff time and encouraging the incoming resident to begin each handoff with a scripted text ("Are you ready for today's handoff, or do you need a little more time?") thereby encouraging the outgoing resident to take a few more minutes to mentally prepare for the handoff. Another possibility is to encourage the incoming resident to review patient records prior to the handoff and to alert the outgoing resident that he or she has done so.

Training represents another important intervention to support handoff preparation. Training that explicitly addresses the cognitive load of handoff preparation may aid new interns and residents in developing the skills they need to become competent in both the outgoing and incoming resident roles. Scenario-based simulation training that presents important challenges (for example, complex patients, rapid changes in patient status, nonmedical issues that influence patient care) can help residents experience these cognitive challenges in a safe environment where they can practice the necessary cognitive and communication skills.[37,38] Interruptions during handoff preparation are essentially unavoidable, and there may be value in developing practice scenarios in which the time to prepare for a handoff is abbreviated or interrupted so that residents learn to master adaptation techniques to minimize the impact of distractions/disruptions during handoffs. Cognitive skills training may help residents establish common ground about differing responsibilities for day vs. night shift as well as how to effectively create the distributed cognition required for effective continuity of care.[39,40]

Our study has several limitations. It was conducted exclusively in medical and surgical units in the VA health care system, which has its own distinct health care delivery system and unique organizational characteristics, and thus the study may have limited external generalizability. It is important to note however that, because participants in this study were residents who rotated through a series of hospital systems, it is likely that our findings have relevance beyond the VA health system. It is also worth noting that themes identified were consistent in all three sites despite the convenience sample; however, it is possible that additional themes would emerge with a larger sample across a broader range of clinical contexts. A second limitation is that we did not observe preparation activities and were not able to ask questions in the moment. Although the majority of the interviews were conducted within 24 hours after the previous shift, some residents interviewed had not completed handoffs in more than a week. Future studies that incorporate observations with opportunistic interviews would likely provide additional insights to our findings. A third limitation is that we focused on handoffs from day shift to night shift, limiting generalizability to other types of handoffs. In fact, we anticipate that preparation for handoffs from night shift to day shift is less complex and qualitatively different, given the different roles and responsibilities associated with each shift. A fourth limitation is that our convenience sample did not provide an adequate distribution of experience levels to permit analysis of differences between postgraduate year (PGY)-1, PGY-2, and PGY-3 residents, or between medical and surgical specialties. A fifth limitation is that our focus was on the perspective of the outgoing resident; additional insights might be revealed by exploring the perspective and information needs of the incoming resident.

CONCLUSION

Our study advances the understanding of the influence of the cognitive tasks residents engage in as they prepare to hand off patients from day shift to night shift. Because handoffs have been identified as a common point of failure in health systems, they represent an important leverage point for improving patient safety and system resilience. In fact, care coordination has been identified as an important juncture for improving resilience in complex sociotechnical systems in general, and in health care specifically.[41–45] Our research focuses on cognitive preparation for the handoff—activities critical to effective coordination yet easily overlooked because they are not readily observable. The cognitive activities identified point to strategies for cognitive support via improved technology, organizational interventions, and enhanced training. Supporting underlying cognitive tasks will increase the ability of residents to conduct effective handoffs under a wide variety of conditions and clinical contexts, a key tenant of resilience engineering.[31] Our focus on system resilience provides a broader view on strategies to standardize handoff content and provides a more realistic (naturalistic) approach to supporting residents in coping with the complexities of day-to-night end-of-shift handoffs.

Laura G. Militello, MA, is Senior Scientist, Applied Decision Science, LLC, Kettering, Ohio. **Nicholas A. Rattray, PhD,** is Research Health Scientist, US Department of Veterans Affairs, Health Services Research and Development Service, Center for Health Information and Communication (VA HSR&D CHIC), Richard L. Roudebush VA Medical Center, Indianapolis, and Adjunct Assistant Professor, Department of Anthropology, Indiana University–Purdue University Indianapolis. **Mindy E. Flanagan, PhD,** is Senior Research Consultant with Health Services Research and Development Service, Richard L. Roudebush VA Medical Center, Indianapolis and Senior Research Scientist with Parkview Health, Fort Wayne, IN; and **Zamal Franks, BA,** is Program Specialist, VA HSR&D CHIC. **Shakaib Rehman, MD,** is Associate Chief of Staff for Education, Phoenix VA Healthcare System, and Professor, Department of Biomedical Informatics, University of Arizona College of Medicine, Phoenix. **Howard S. Gordon, MD,** is Staff Physician, Jesse Brown VAMC, Center of Innovation for Complex Chronic Healthcare, and Professor of Medicine, University of Illinois at Chicago. **Paul Barach, MD, MPH,** is Clinical Professor, Children's Hospital of Michigan, Wayne State University School of Medicine. **Richard M. Frankel, PhD,** is Senior Scientist, VA HSR&D CHIC, and Professor of Medicine and Geriatrics, Indiana University School of Medicine. Please address correspondence to Laura G. Militello, l.militello@applieddecisionscience.com.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at doi: 10.1016/j.jcjq .2018.02.005

REFERENCES

1. Riesenberg LA, et al. Residents' and attending physicians' handoffs: a systematic review of the literature. Acad Med. 2009;84:1775–1787.
2. Keyes C. Coordination of care provision: the role of the "handoff. Int J Qual Health Care. 2000;12:519.
3. Gandhi TK. Fumbled handoffs: one dropped ball after another. Ann Intern Med. 2005 Mar 1;142:352–358.
4. The Joint Commission. Joint Commission Center for Transforming Healthcare releases Targeted Solutions Tool for hand-off communications. Jt Comm Perspect. 2012;32(8):1–3.
5. Accreditation Council for Graduate Medical Education (ACGME). Clinical responsibilities, teamwork, and transitions of care. In: ACGME Common Program Requirements: Section VI with Background and Intent. Chicago: ACGME, 2017, 12–13 Accessed Apr 12, 2018. https://www.acgme .org/Portals/0/PFAssets/ProgramRequirements/CPRs _Section%20VI_with-Background-and-Intent_2017-01.pdf.
6. Hesselink G, et al. Improving patient handovers from hospital to primary care: a systematic review. Ann Intern Med. 2012 Sep 18;157:417–428.
7. Riesenberg LA, Leitzsch J, Little BW. Systematic review of handoff mnemonics literature. Am J Med Qual. 2009;24:196–204.
8. Riesenberg LA. Shift-to-shift handoff research: where do we go from here? J Grad Med Educ. 2012;4:4–8. Accessed Apr 12, 2018. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3312531/.
9. Starmer AJ, et al. Development, implementation, and dissemination of the I-PASS Handoff Curriculum: a multisite educational intervention to improve patient handoffs. Acad Med. 2014;89:876–884.
10. Starmer AJ, et al. Changes in medical errors after implementation of a handoff program. N Engl J Med. 2014 Nov 6;371:1803–1812.
11. Cohen MD, Hilligoss PB. The published literature on handoffs in hospitals: deficiencies identified in an extensive review. Qual Saf Health Care. 2010;19:493–497.
12. Keebler JR, et al. Meta-analyses of the effects of standardized handoff protocols on patient, provider, and organizational outcomes. Hum Factors. 2016;58:1187–1205.
13. Patterson ES, Wears RL. Patient handoffs: standardized and reliable measurement tools remain elusive. Jt Comm J Qual Patient Saf. 2010;36:52–61.
14. O'Brien CM, et al. Anybody on this list that you're more worried about?" Qualitative analysis exploring the functions of questions during end of shift handoffs. BMJ Qual Saf. 2016;25:76–83.
15. Militello LG, Hutton RJ. Applied cognitive task analysis (ACTA): a practitioner's toolkit for understanding cognitive task demands. Ergonomics. 1998;41:1618–1641.
16. Heckathorn DD. Snowball versus respondent-driven sampling. Sociol Methodol. 2011 Aug 1;41:355–366.
17. Bernard HR. Research Methods in Anthropology: Qualitative and Quantitative Approaches, 5th ed. Plymouth, UK: Altamira, 2011.
18. Kadushin C. Power, influence and social circles: a new methodology for studying opinion makers. Am Sociol Rev. 1968;33:685–699.
19. Helms AS, et al. Use of an appreciative inquiry approach to improve resident sign-out in an era of multiple shift changes. J Gen Intern Med. 2012;27:287–291.
20. Christensen RE, Fetters MD, Green LA. Opening the black box: cognitive strategies in family practice. Ann Fam Med. 2005;3:144–150.
21. Dominguez C, et al. Perception-action coupling in endoscopic surgery: a cognitive task analysis approach. In: Bardy BG, Bootsma RJ, Guiard Y, editors. Studies in Perception and Action III. Mawah, NJ: Lawrence Erlbaum Associates, 1995, 285–288.
22. Crandall B, Getchell-Reiter K. Critical decision method: a technique for eliciting concrete assessment indicators from the intuition of NICU nurses. ANS Adv Nurs Sci. 1993;16:42–51.
23. Patterson MD, et al. Leveraging the critical decision method to develop simulation-based training for early recognition of sepsis. J Cogn Eng Decis Mak. 2016;10:36–56.
24. Young JQ, et al. Advancing the next generation of handover research and practice with cognitive load theory. BMJ Qual Saf. 2016;25:66–70.
25. Young JQ, et al. Performance of a cognitive load inventory during simulated handoffs: evidence for validity. SAGE Open Med. 2016 Dec 14;4:2050312116682254.
26. Glaser BG, Strauss AL. The Discovery of Grounded Theory: Stategies for Qualitative Research. New York City: Aldine, 1967.
27. Corbin JM, Strauss A. Grounded theory research: procedures, canons, and evaluative criteria. Qual Sociol. 1990;13:3–21.
28. Shroff D, et al. Physician-to-physician handoff: the Veterans Affairs Cairo Project. J Hosp Med. 2008;3:69–70.
29. Jeffcott SA, Ibrahim JE, Cameron PA. Resilience in healthcare and clinical handover. Qual Saf Health Care. 2009;18:256–260.
30. Bergman AA, et al. "Mr Smith's been our problem child today . . .": anticipatory management communication (AMC) in VA end-of-shift medicine and nursing handoffs. BMJ Qual Saf. 2016;25:84–91.
31. Hollnagel E. Prologue: the scope of resilience engineering. In: Hollnagel E, et al., editors. Resilience Engineering in Practice: A Guidebook. Boca Raton, FL: CRC Press, 2011, xxix–xxxix.

32. Hollnagel E, Woods DD, Leveson N, editors. Resilience Engineering: Concepts and Precepts. Farnham, UK: Ashgate, 2006.

33. Weick KE, Sutcliffe KM. Managing the Unexpected: Resilient Performance in an Age of Uncertainty, 2nd ed. San Francisco: Jossey-Bass, 2007.

34. Randell R, et al. Beyond handover: supporting awareness for continuous coverage. Cogn Technol Work. 2010;12:271–283.

35. Patterson ES, et al. Collaborative cross-checking to enhance resilience. Cogn Technol Work. 2007;9:155–162.

36. Westbrook JI, et al. The impact of interruptions on clinical task completion. Qual Saf Health Care. 2010;19:284–289.

37. Kendall L, et al. Use of simulated physician handoffs to study cross-cover chart biopsy in the electronic medical record. AMIA Annu Symp Proc. 2013 Nov 16;2013:766–775.

38. Drachsler H, et al. The Handover Toolbox: a knowledge exchange and training platform for improving patient care. BMJ Qual Saf. 2012;21(Suppl 1):i114–i120.

39. Kicken W, et al. Handover training: does one size fit all? The merits of mass customisation. BMJ Qual Saf. 2012;21(Suppl 1):i84–i88.

40. Toccafondi G, et al. The collaborative communication model for patient handover at the interface between high-acuity and low-acuity care. BMJ Qual Saf. 2012;21(Suppl 1):i58–i66.

41. Nyssen AS. From myopic coordination to resilience in socio-technical systems. A case study in a hospital. In: Hollnagel E, et al., editors. Resilience Engineering in Practice: A Guidebook. Boca Raton, FL: CRC Press, 2011, 219–235.

42. Carayon P, Xie A, Kianfar S. Human factors and ergonomics as a patient safety practice. BMJ Qual Saf. 2014;23:196–205.

43. Furniss D, et al. Unintentional non-adherence: can a spoon full of resilience help the medicine go down? BMJ Qual Saf. 2014;23:95–98.

44. Smith MW, et al. Resilient actions in the diagnostic process and system performance. BMJ Qual Saf. 2013;22:1006–1013.

45. Brattheim B, Faxvaag A, Seim A. Process support for risk mitigation: a case study of variability and resilience in vascular surgery. BMJ Qual Saf. 2011;20:672–679.