Research Article

Performance-Shaping Factors Affecting Older Adults' Hospital-to-Home Transition Success: A Systems Approach

Nicole E. Werner, Ph.D.¹, Michelle Tong, B.S.¹, Amy Borkenhagen, M.S.¹, and Richard J. Holden, Ph.D.^{2,*}

¹Department of Industrial and Systems Engineering, University of Wisconsin-Madison. ²School of Informatics and Computing, Indiana University-Purdue University Indianapolis.

*Address correspondence to Richard J. Holden, School of Informatics and Computing, Indiana University-Purdue University Indianapolis, Suite 190, Walker Plaza, 719 Indiana Ave, Indianapolis, IN 46202. E-mail: rjholden@iupui.edu

Received: August 8, 2017; Editorial Decision Date: October 30, 2017

Decision Editor: Rachel Pruchno, PhD

Abstract

Background and Objectives: Facilitating older adults' successful hospital-to-home transitions remains a persistent challenge. To address this challenge, we applied a systems lens to identify and understand the performance-shaping factors (PSFs) related older adults' hospital-to-home transition success.

Research Design and Methods: This study was a secondary analysis of semi-structured interviews from older adults ($N = 31$) recently discharged from a hospital and their informal caregivers ($N = 13$). We used a Human Factors Engineering approach to guide qualitative thematic analysis to develop four themes concerning the system conditions shaping hospital-to-home transition success.

Results: The four themes concerning PSFs were: (a) the hospital-to-home transition was a complex multiphase process—the process unfolded over several months and required substantial, persistent investment/effort; (b) there were unmet needs for specialized tools—information and resources provided at hospital discharge were not aligned with requirements for transition success; (c) alignment of self-care routines with transition needs—pre-hospitalization routines could be supportive/disruptive and could deteriorate/be re-established; and (d) changing levels of work demand and capacity during the transition—demand often exceeded capacity leading to work overload.

Discussion and Implications: Our findings highlight that the transition is not an episodic event, but rather a longitudinal process extending beyond the days just after hospital discharge. Transition interventions to improve older adults' hospital-to-home transitions need to account for this complex multiphase process. Future interventions must be developed to support older adults and informal caregivers in navigating the establishment and re-establishment of routines and managing work demands and capacity during the transition process.

Keywords: Human Factors Engineering, Heart failure, Self-care, Self-management, Hospital discharge, Patient safety

Background and Objectives

Care transitions from the hospital to home are a vulnerable period in the continuum of care for older adults (Arbaje et al., 2014; Jencks, Williams, & Coleman, 2009). Care transitions refer to the movement of an older adult from one setting of care to another, where settings could include a hospital, ambulatory care, primary or specialty care

practice, long-term care, home health care, or rehabilitation facility (Coleman, 2003). Research over two decades consistently shows care transitions are frequent, complex, and risky for older adults (Kripalani, Jackson, Schnipper, & Coleman, 2007; Rennke & Ranji, 2015). Older adults are particularly vulnerable to transition-related risks after hospital discharge (Jencks et al., 2009), experiencing more

frequent transitions and subsequent hospital readmissions compared to other populations (Coleman & Berenson, 2004; Murtaugh & Litke, 2002). This has been attributed to factors such as older adults' complex therapeutic regimens (Anderson & Horvath, 2004) and susceptibility to functional decline and delirium during hospitalizations (Creditor, 1993; Fernandez, Callahan, Likourezos, & Leipzig, 2008). To improve hospital-to-home care transition outcomes for older adults, an important prerequisite is a better understanding of the challenges older adults face during the hospital-to-home transition.

Improving Care Transitions of Older Adults

Annually, 22% of older adults experience a hospital transition; of these, half experience multiple transitions (Sato, Shaffer, Arbaje, & Zuckerman, 2011). In addition, 20% of older adults experience a preventable adverse event during the three week post-discharge period (Forster, Murff, Peterson, Gandhi, & Bates, 2003), such as medication errors, infections, and falls (Coleman, 2003; Forster et al., 2003; Mansah, Fernandez, Griffiths, & Chang, 2009).

Care transition interventions for older adults have produced mixed results (Rennke, Nguyen, Shoen, Magan, & Wachter, 2013). One of several proposed explanations is the focus of many interventions on optimizing pre-discharge factors such as patient education and discharge readiness, rather than post-discharge factors such as resources for self-management and skills for resolving unforeseen challenges (Jack, Chetty, Anthony, Greenwald, & Sanchez, 2009). In support of this gap, a recent study found that over 50% of patients reported difficulty executing the hospital discharge plan "even though the vast majority reported no difficulties understanding what they were supposed to do" (Horwitz, 2017). Thus, to improve care transition outcomes for older adults, future efforts should also discover and address conditions in the post-discharge period of the hospital-to-home transition that shape older adults' performance.

Understanding the Complex Post-Hospital Discharge System Through a Systems Lens

A systems approach enables the identification of conditions shaping performance beyond those focused on the individual (Salvendy, 2012). Human Factors Engineering is a human-centered, systems-oriented science and practice increasingly applied to study performance in health care (Carayon, 2016; Xie & Carayon, 2015). Human Factors produces models and methods that both guide the study of and provide a framework for improving conditions shaping performance. Performance-shaping factors (PSFs) refer to influencers that either enhance or degrade performance (Hollnagel, Kaarstad, & Lee, 1999). PSFs are often assessed in human error research and accident analysis, when performance-shaping system conditions needed to be identified as to what caused or could cause an accident

(Holden & Karsh, 2007). Human Factors is well-suited to complex phenomena such as care transitions because it takes into account multiple interacting system factors at different levels of analysis and attends to both structure and process (Carayon, 2006; Karsh, Waterson, & Holden, 2014; Werner, Gurses, Leff, & Arbaje, 2016). Of present relevance, recent Human Factors research has examined the system conditions shaping the self-management performance of chronically ill patients and their informal caregivers, revealing multiple often interacting PSFs (Holden, Schubert, & Mickelson, 2015; Holden, Valdez, Schubert, Thompson, & Hundt, 2017). Such studies provide insights into system redesign to support older adults and informal caregivers in accomplishing health-related "work," beyond simply instructing or educating them on its performance. Applied to post-hospital care transitions, a systems approach would examine the following performance-shaping system conditions: (a) structural factors—e.g., people, technologies, tasks, organization, environment—contributing to post-discharge processes and outcomes; (b) the nature and evolution of the performance processes or activities present (or absent) post-discharge; and (c) the outcomes of the system's structures and processes.

Objectives

The purpose of this study was to apply a systems lens to identify and understand the PSFs related to the success of older adults' hospital-to-home transitions.

Research Design and Methods

Design

We conducted a secondary analysis of semi-structured interview data from older adults who were recently discharged from a hospital and their informal caregivers. Data were collected in 2012–2013 in author RJH's study of geriatric heart failure self-care. Older adults were recruited from a cohort of adults hospitalized for heart failure or myocardial infarction in the Vanderbilt Inpatient Cohort Study (VICS). Caring Hearts and VICS were approved by the Vanderbilt University Institutional Review Board. Recruitment and data collection methods are detailed elsewhere (Holden, Schubert, & Mickelson, 2015; Meyers et al., 2014; Srinivas, Cornet, & Holden, 2016).

Participants

Participants were 31 older adults (M age = 73 years; range = 65–86 years) diagnosed with heart failure living in urban, rural, and suburban regions of Tennessee and Kentucky. Older adults were recruited a mean of 57 days of being discharged from Vanderbilt University Hospital (range = 36–101 days). Table 1 details older adults' demographic characteristics. In addition, 13 informal caregivers (i.e.,

Table 1. Older adults' demographic characteristics

Older adult characteristic	N = 31
Age in years (mean; range)	72.61; 65–86
Gender (Female %)	52
Race/ethnicity (%)	
African American	13
Caucasian	87
Years of school (%)	
12 Years	39
13–16 Years	45
>16 Years	16
Years with congestive heart failure (%)	
1 or less	26
2 to 5	26
5 to 10	16
10 to 20	13
20+	6
Number of medications (mean; range)	17 (9–29)

family members or friends) were included in patient interviews as secondary informants.

Procedure

Older adults and caregivers who consented to the study participated in semi-structured interviews lasting 90–120 minutes in total. Participants were either interviewed at home or observed during a scheduled clinic visit with clinician consent, briefly interviewed, and then interviewed again in their homes. Patients and caregivers were interviewed together. Interview questions, based on Human Factors systems models, were designed to fully understand participants': (a) personal characteristics; (b) tools and technologies; (c) contexts, including living arrangements, social situation, financial resources, and the physical environment; and (d) tasks and processes, including those related to the pre- and post-hospitalization periods. Data were captured with audio and, when permitted, video recording. The study paid participants up to \$65 for completing all study phases.

Analysis

Interview audio recordings were transcribed verbatim and analyzed using NVivo 11 qualitative data analysis software (QSR International). We conducted qualitative thematic analysis to develop and elaborate themes related to the system conditions that shaped performance during the hospital-to-home transition. Team analysts had training in industrial or biomedical engineering, Human Factors, and psychology, including two investigators with aging-related research experience. The senior investigator also had considerable familiarity with the data set and expertise in qualitative data analysis. Caregivers were interviewed with the older adults and their data were analyzed in the transcripts

along with the data of older adults. Separate analyses of caregivers were not performed.

During analysis, we first identified a set of research questions guided by current literature on care transitions and by a Human Factors systems perspective. The systems perspective directed the analysis toward (a) the structural factors that interact to constitute hospital-to-home transition processes and outcomes; (b) the nature and evolution of the processes or activities present (or absent) post-discharge; and (c) the outcomes that result from hospital-to-home transition structures and processes.

One member of the research team (NW) then performed structural coding on one third of transcripts to select broad passages related to care transitions (Saldaña, 2015), defined as: the movement of a patient from one healthcare provider or setting to another (Coleman, 2003), and the transfer of the burden of care from one individual or team of individuals to another.

Next, two members of the research team (RJH, NW) analyzed the structurally coded passages and independently listed recurring themes within the scope of the research objective. They met and discussed their independently identified themes, which were similar enough to combine by consensus into six broad themes, which were subsequently collapsed into four themes concerning PSFs affecting hospital-to-home transition success. These were then defined and illustrated in a codebook.

Two researchers not involved with initial theme development (MT, AB) then used the codebook to perform directed coding on another subset of transcripts. They reported that the four themes adequately captured the experiences described in the interviews. Minor adjustments were made at this point to the wording and definitions of the themes.

Once the research team (RJH, NW, MT, AB) agreed on the four themes and their definitions, two research team members (MT, AB) coded all the transcripts, categorizing interview data by theme. A subset of the research team (NW, MT, AB) met regularly to review coding progress and discuss whether to modify or add to the original themes. Decisions were also discussed with a senior researcher (RJH). In this way, the team avoided the intersubjectivity of multiple analysts while ensuring that the two coders were following the codebook and benefiting from the input of a multidisciplinary team. Special effort was made to identify contrasting cases both within and between participants to better understand what makes successful and unsuccessful post-discharge work performance.

Coding reliability and consistency were managed throughout the coding process through regular discussions among a subset of the research team (AB, MT, NW). During discussions, instances in which the coders disagreed were resolved through consensus. We also measured rater agreement using NVivo 11 to assess interrater consistency at each discussion point. Agreement ranged from 90% to 97% and increased over time.

Results

We found that hospital-to-home transition work performance required considerable time and effort from older adults. Subsequently, we elaborate the four themes regarding system conditions shaping performance during older adults' hospital-to-home transitions, reporting representative quotations for each. One older adult highlighted this experience:

But you know what? When they tell us all of this stuff in the hospital we don't get it. We just don't get it right then. That's not really, it should be told then in case you do get a little something, but it needs to be repeated three or four times before we finally get it on something like, especially like sodium or heart failure. (74 y/o White Female)

PSF 1: Complexity of the Transition Process

Older adults experienced the hospital-to-home transition not as a singular event but as a complex multiphase process that unfolded over several months and required substantial, persistent investment and effort from older adults and informal caregivers. Four phases of this process could be distinguished (Figure 1). Across all the phases, older adults described a need for increased and continuous training and resources related to understanding and implementing their new self-care.

Transition Phase 1: Transferring Roles and Responsibilities

In Phase 1, older adults described taking on more active roles as the responsibility of care was rapidly transferred from hospital providers taking care of every disease management need, to older adults and their informal caregivers. For example, one participant explained how in the hospital, she was the passive recipient of medications, but at home medications became her responsibility. Another summarized this transfer of responsibility:

The nurses and the doctors, of course tend you while you're here and then when you go home, you're kinda on your own. You're kinda flyin' by the seat of your britches. (65 y/o White Female)

Transition Phase 2: Establishing Self-Care Routines

The second phase required establishing new self-care routines based on the care plan provided by the hospital. Described more fully in the next theme, post-discharge routines were particularly challenging to establish from scratch:

Just, oh, it's so hard at this particular age. I can do it much easier if I was 50 or maybe 60 to see the sodium intake on each one of those and trying to figure out how much is per serving and those kinds of things. I found it so hard to do....it takes so long to do it, you know. (74 y/o White Female)

Transition Phase 3: Integrating Self-Care Routines

In the third transition phase, older adults continued integrating newly established routines into their daily lives. New routines such as grocery shopping for low-sodium foods could become a central part of a typical day:

Well, they taught, or tried to teach me to read the stuff on the box. Or course, the older you get the harder it is to read. They said a magnifying glass. I said I got that but I don't usually go into the grocery store with a magnifying glass. It takes me two hours to shop to get groceries and I have to do that like in a wheelchair now because of my back. (74 y/o White Female)

When multiple new routines were integrated at home during the hospital-to-home transition, the integration process typically lasted several weeks or months and required coordinating new self-care tasks, secondary tasks such as medical appointments and personal obligations:

Figure 1. Timeline of the hospital-to-home transition process with transition phases.

I have to go to the bathroom, take my thyroid pills, two of them and wait half hour before you eat, I weigh myself, do my blood pressure and my heart rate, uh, do my insulin reading.... And then I get up and you start making phone calls after a little while. There's usually somebody to call every day to straighten something out that they missed the phone, you know? Every day is phone calls. ...We have to call the insurance this morning and I've got to call the doctor and the, the, uh, medical supplies. (74 y/o White Female)

Transition Phase 4: Managing New Needs and Challenges

In the fourth phase, older adults reported continuous adjustment lasting up to three months after discharge. During this time, older adults continued to integrate self-care routines into daily life but also experienced new challenges and the need for new resources and information:

I think that I'm in need of more information. Maybe even different information that what I already know or have, um or even refresh me you know. You forget a lot. (65 y/o White Female)

PSF 2: Unmet Need for Specialized Transition Tools

Our results suggest that the information and resources provided at the point of hospital discharge were not a "fit" for what older adults and informal caregivers required to be successful during the multistage hospital-to-home transition process. Older adults' hospital-to-home transition performance suffered when they lacked the information and resources to progress through these phases. In early stages of the transitions, older adults needed more information than they had on how to implement recommended care plans and how to integrate new routines, such as new medication prescriptions, into their lives. For example, one participant described wanting to take medications once per day, but being discharged with a more complex dosing schedule. Others described being instructed to adhere to low-sodium diets but not receiving low-sodium recipes or help financing the new diet: "doctors don't understand financial burden." In early stages, older adults were also under-informed about their new roles and responsibilities, including the purpose of new routines:

I still don't totally agree [about limiting my fluid intake]; I need a doctor or something to tell me more about why your body doesn't process fluids like it does when you're not [in heart failure]. It seems like when you, if you drink, uh, I mean most diets and things tell you to drink a lot of water and it helps flush stuff out of your body. And it always seemed to me like if I drank a lot of water not only would I lose weight, but the color of the urine would get darker too, which would kind of show you were getting

rid of junk you know along with the water. But, but I don't know, I didn't know that's why they were giving me little tiny glasses of water [in the hospital] when I'd say I'm thirsty, could I have some water? [The hospital providers would say] oh sure here's this much with a little ice in it. I'd think, could I have some more water, yeah, and I thought why can't they bring me a decent size glass of water. And then the doctor says, we really don't want you to have a lot of water. Okay, why didn't you tell me that to begin with, you know? (67 y/o White Female)

Older adults also described not receiving adequate preparation at the point of hospital discharge to address emerging challenges weeks or months into the hospital-to-home transition process, such as problems with new medications or lifestyle changes. One older adult did not get a direct answer when explicitly asking what could be done differently:

They haven't said. I tried to get an answer out of 'em today on that very question. (66 y/o White Male)

PSF 3: Alignment of Self-Care Routines With Hospital-to-Home Transition Needs

As noted above, participants reported establishing or re-establishing routines—collections of habits that result in patterns of activity—during the hospital-to-home transition. We found that routines could be disrupted as a result of hospitalization or deteriorating health but could also be re-established to some extent, as in this example of exercise:

When I told that to Dr. Doe, he said you go to the Rec Center every day and I said, yeah, I don't, I stopped going on Sundays since the heart thing has developed because Sunday's a long day and we go to church and have to get up real early to get ready and they pick me up at 10 after 8 and uh then lunch and by the time I get back home I'm zapped so I read the paper and stay in.... (83 y/o White Female)

We found that pre-existing routines could either facilitate or impede hospital-to-home transition performance, depending on whether they aligned with older adults' transition needs, illustrated in Table 2, and highlighted by this older adult's description of how her eating changed over the multiphase transition process:

At, at first, when I was first home, yes. I watched very closely what I ate, and, and all of that. But, I have kind of settled back into, uh, the routine that I had before, uh, eating the foods that I, I ate before. (65 y/o White Female)

Participants described multiple barriers to constructing or reconstructing routines. Sometimes there were multiple barriers acting in sequence. One older adult described physical limitations that prevented her from easily navigating the grocery store to find low-salt foods, financial limitations that prohibited her from purchasing low-salt foods, and resource limitations in which she did not know how

Table 2. Examples Illustrating Alignment or Misalignment Between Prehospitalization Routines and Hospital-to-Home Transition Needs

Alignment between prehospitalization routine and hospital-to-home transition needs	Misalignment between prehospitalization routine and hospital-to-home transition needs
<p>Healthy dietary habits</p> <p>“And I took care of her and so for years and years I worked, but I would always cook the night before and leave things, the veggies and the fruits for her to have. And so we just lived on, that way, proper nutrition.” (81 y/o White Female)</p> <p>Low fluid intake habits</p> <p>“Well you know I don’t really drink. I may drink a bottle of water, but, uh, that’s about it.” (68 y/o White Female)</p> <p>High physical activity habits</p> <p>“I’ve always exercised always. For years. You know I used to play ball when I was young cause I’m 70 now, so I’m not young, but I played ball, used to do yoga and uh and I’ve always been an exercise nut and my-my family always said I was a health nut.” (69 year-old Black Female)</p>	<p>High-sodium dietary habits</p> <p>“I’ve always liked my Worcestershire sauce [high in sodium] in my vegetable soup and then on my green beans, cause bubba like it in his, so I’ve just always done that it’s just a habit it just made ‘em taste better so I just do it.” (70 y/o White Male)</p> <p>High fluid intake habits</p> <p>“I suppose limiting fluids is the-the toughest cause I was a water drinker; I drank a bottle of water every hour.” (83 y/o White Female)</p> <p>Low physical activity habits</p> <p>“I’ve gotten myself into such a, uh, a stalemate you might say of, you know, just sittin’ in a chair and that’s basically where my life has been for years, is just there in that chair.” (65 y/o White Male)</p>

to access recipes that fit the low-salt dietary restriction. In contrast, some reported a single major or persistent barrier. For example, one participant had difficulty controlling her fluid intake, citing a strong prehospitalization habit: “I drank a gallon of water just about every day” (65 y/o White Female). Table 3 provides additional representative examples of the barriers to constructing and reconstructing hospital-to-home transition routines.

PSF 4: Workload Changes and Work Overload During Hospital-to-Home Transitions

Our results revealed that during the transition process, older adults and caregivers experienced changing levels of work demand and capacity. Demand, or the amount of resources, time, and effort required to perform self-care work, fluctuated but typically peaked during the first transition phase of transferring roles and care responsibility, before being lowered:

So, I go back to work this coming Saturday. But, I had to really work hard to regain strength, you know. I had, uh, an occupational therapist and a physical therapist and a nurse that came here, uh, for several weeks. And then I just do exercises on my own. I’m bored to death now, because I don’t have anything to do, you know. (65 y/o White Female)

Capacity, or one’s abilities, resources, or readiness to address demands also varied, for example, depending on whether and when an informal caregiver was available to assist:

Thank goodness [caregiver name] is there to kind of keep up with [medications] for me. Cause she’s got them in a, in a daily thing and she’ll dump them out in a cup and then I’ll take them. So I really don’t keep up with

how many I take and all that, I just depend on her to do that. (70 y/o White Male)

We identified several factors affecting an older adult’s level of work demand and work capacity during the transition, such as feeling fatigued, stressed, and sick, in-home support, length of time managing CHF, and socioeconomic factors, illustrated in Table 4. Some work capacity factors, such as informal caregiver support, could compensate for others such as physical limitations.

Demand–Capacity Relationship

Participants described the relationship between demands and capacity, for example, how high demands could be frustrating or acceptable depending on their capacity at the time:

Well as far as the you know the doing all the monitoring and stuff, with you know calling it in or putting it on the computer or however, you know if it’s not multiple times, you know there are times that it gets extremely frustrating and um, you know and then other times it fits into your schedule very well but you know that’s not predictable. (70 y/o White Male)

The demand–capacity relationship differed by individual. For example, certain tasks such as getting dressed were perceived as easy for a person with high physical capacity but exhausting for those with physical capacity limitations:

I have trouble getting my socks on. I have trouble getting clothes on. I just ain’t got it all together no more about doing things for myself. I can get my shoes on, but that’s because they loose enough that I can slip ‘em on without doing a whole lot of work. Time I, uh, get washed up and everything, well, it’s, that’s about exhausted me. (76 y/o White Male)

Table 3. Example Barriers to Constructing or Reconstructing Self-Care Routines During Hospital-to-Home Transitions, With Illustrative Quotations

Hospital-to-home transition need	Barrier type	Barrier to constructing or reconstructing self-care routine during the hospital-to-home transition and illustrative quotation
Limit sodium intake	Person—individual goals	Eating habits “Nutrition, I haven’t heard much of anything about, other than they say stay away from salt and I’ll admit my favorite food is Mexican chips and dip. ... I don’t wanna be totally separated from something I really, really like.” (66 y/o White Male)
Limit fluid intake	Organization—communicating needs	Multiple health conditions create conflicts “Yeah, they said to limit my uh liquid intake to uh 200 milliliters, does that sound right or 2,000 milliliters? ... You know more like the equivalent of a two liter coke ... I limit my fluid intake on a daily basis to that and I’m sure I went over ... but when you’re diabetic you’re thirsty too.” (66 y/o White Male)
Eat healthy foods such as fresh fruits and vegetables	Environment—community access	Ability to afford healthy foods “I’m not so good on the eating. I, I can’t really afford to buy the food the way they want me to, you know, the, uh, salt free and, and, and all of that” (65 y/o White Female)
Exercise regularly	Person—physical ability	Ability to perform exercise “He says I need to get out and walk, but I ain’t able to walk. I just can’t go no more without completely getting out of breath. Yeah, now, I stop and rest when I get out of breath and sit there a few minutes, or stand there, or lean up against something. I sometimes, I’m plum dizzy and I have to hold on to something after I stop, but, uh, some, most of the time, I get to, if I see a place to sit down, that’s where I sit down.” (76 y/o White Male)
Cook at home instead of eating out	Tools and technology—information availability	Lack of recipes “When uh, when they first uh, when they told me you know that I was going to have to do this and everything, they gave me a site to go on and that’s what I said, it was, they, they give you all good information, but they give you very little recipes you know and if they want you to be on this type of diet and all I think they need to get together and get a book and hand it to the person because then I don’t think she or he will be overwhelmed like I was” (68 y/o White Female)
Take medication as instructed	Organization—communicating treatment plan Person—comprehension of treatment plan	Communication/Comprehension of treatment plan purpose “And they started me off on insulin and, uh, you know, I just, I couldn’t understand, I just knew I couldn’t see me giving myself four shots a day for the rest of my life, I just, I had no desire to do that.” (80 y/o Black Male)

In some cases, participants described using their whole capacity to manage demand to avoid performance failures, for example, having to be rehospitalized:

Well, we do everything that we think we can humanly can do to keep me out of the hospital because we, we work really hard at it. I mean, you know, we work hard at the, uh, what I have to eat and drink and do, uh, cause I, certainly ain’t no fun being here. (65 y/o White Male)

Work Overload

Changing levels of demand and capacity during the hospital-to-home transition led to instances of work overload. We identified work overload as a phenomenon when demand exceeded capacity and compromised post-discharge performance. Changing levels of demand and

capacity led to periods of work overload on the order of months, weeks, days, hours, or even minutes:

I don’t do much cooking for friends anymore. I can’t ... I cook maybe twice a week and then I cook enough when I do cook. When my back is so bad, I go and find me, us, a book. I have to sit down 15 [minutes]. Usually I sit down for 5 and then I get back up and do something else, and you know, sit down again. That’s just the way I have to cook. (74 y/o White Female)

Figure 2 depicts a composite of older adults’ hospital-to-home transition demand and capacity changes, including cases of work overload and underload. Although older adults’ experienced unique demand and capacity fluctuations, many described the significant increase in demand immediately post-discharge, followed by resolution and then new, sometimes unexpected demands as time progressed.

Table 4. Factors Influencing the Capacity of Older Adults in the Hospital-to-Home Transition Period

Factor type	Specific factor influencing capacity and illustrative quotation
Other “work” demands	Responsible for taking care of others “Well I should have gone [to the doctor] sooner. And my wife’s physical condition is... anything but good...If it had been easy to get, uh, get someone to be with her, I would have probably gone in sooner, yeah.” (83 y/o White Male)
Multimorbidity	Comorbid conditions “You straighten the kidneys out, the heart messes up. You straighten the heart out, the kidneys mess up. You got to-- And then I’m diabetic too, so.” (68 y/o White Female)
Health literacy	Ability to understand health information “I’m taking my Lasix. I mean why am I actually accumulating this, why am I accumulating this fluid. And, uh, the answer is did I drink a lot of water, I said yes, well they said well don’t drink, don’t drink over two liters a day. Two liters? I’m not going to drink no two liters no day.” (67 y/o Black Female)
Illness history	Length of illness “I have a spiritual foundation that supports me, but I’ve given up, I mean haven’t given up on that, but on all the other stuff I’ve given up. I just can’t fight anymore.” (68 y/o White Male)
Mental health	Emotional and psychological state “It has caused me more anxiety than anything I’ve had before.” (67 y/o White Female)
Social support	Informal caregiver social support “I’ve noticed that people really don’t wanna come over that much you know and since this happened and uh that’s been hard.” (65 y/o White Female)
Socioeconomic status	Ability to afford paid help “I’m just exhausted. It’s only been 3 or 4 months. (I: What do you, what do you think would change that?) Fulltime housekeeper. (I: A fulltime housekeeper would help that. Does your insurance or anything?) There’s absolutely nothing, nothing.”
Location	Distance from caregiver “She’ll come, if she know I ain’t feeling good, she will come, but she got 30 miles to come, uh, we were classmates, but we’re good friends too.”

Figure 2. Composite depiction of hospital-to-home transition workload experienced by older adults recently discharged from the hospital, including instances of work overload.

Discussion and Implications

A systems lens allowed us to identify performance-shaping system conditions that affect older adults' hospital-to-home transitions. Importantly, our results highlight that the transition is not an episodic event, but rather a longitudinal process that extends beyond the days just after hospital discharge. Consequently, transition tools need to account for

this by providing support for older adults and their informal caregivers in navigating the construction or re-construction of routines and the management of work demands and capacity during the transition process. Our findings are consistent with known persistent transition challenges faced by older adults (Rennke & Ranji, 2015) and represent a guide post for the next generation of hospital-to-home transition interventions.

A Systems Lens for the Next Generation of Transition Tools

Critical to understanding a system is knowing the structural conditions that affect system processes and, subsequently, outcomes (Carayon, 2006). However, because hospital-to-home transitions have not historically been studied from a system perspective, there is a misconception of these transitions as episodic “discharges” rather than a longitudinal process embedded in a structural context. Further, the first-person experiences of older adults and their informal caregivers during the transition process have not been fully examined. The confluence of these factors results in a knowledge gap concerning the PSFs that affect transition success (Werner, Malkana, Gurses, Leff, & Arbaje, 2017). In addressing this gap, this study uncovered PSFs that affect the system’s structure, process, and outcomes. Figure 3 depicts how our resultant themes, depicted as PSFs, map onto a Human Factors systems framework known as the Systems Engineering Initiative for Patient Safety (SEIPS) 2.0 (Holden et al., 2013). SEIPS 2.0 represents a structured work system of interacting elements—tools and technologies; tasks; internal environment; person(s) including patients, informal caregivers, and clinicians; and organization—that produce processes, which generate outcomes. Figure 3 modifies the SEIPS 2.0 model to summarize current study findings by depicting: (a) transition-related PSFs in the work system; (b) the central work processes as a multiphase transition comprised of activities performed by clinicians, older adults, and informal caregivers; and (c) performance outcomes associated with successful or unsuccessful transitions.

As summarized in Figure 3, several of the identified PSFs were structural characteristics of the work system itself, and therefore amenable to redesign (Karsh, Holden, Alper, & Or, 2006). These factors included a need for relevant information and resources, barriers to constructing self-care routines, and the accumulation of demands exceeding patients’ capacities. PSFs in the work system influenced transition processes and ultimately transition success,

evident in traditional outcomes such as medication safety and readmissions, but also in less traditionally measured outcomes such as confidence, comprehension, and workload-related frustration.

The PSFs found in this study stand in contrast to research showing that health care providers may assume a narrow, biomedical scope when providing discharge planning, focusing more on clinical parameters and less on system conditions such as a patient’s access to self-care resources (Granger, Sandelowski, Tahshjain, Swedberg, & Ekman, 2009). This may preclude the provision at discharge of certain kinds of necessary information and resources that impact self-care beyond medical parameters (Holden, Schubert, Eiland, et al., 2015; Holden, Schubert, & Mickelson, 2015). Patients also appear to lack tools to support them, for example, to address barriers or integrate new dietary restrictions and self-monitoring practices into daily routines. In short, patients may be sent home without adequate means to address their post-discharge reality.

The home, an important aspect of this post-discharge reality, is a complex system (Council, 2011; Holden, Schubert, & Mickelson, 2015; Or et al., 2011). Its structural properties differ markedly from those of clinical settings (Holden, Schubert, Eiland et al., 2015; Holden, Schubert, & Mickelson, 2015; Holden et al., 2017). Currently, hospital clinicians preparing older adults for the hospital-to-home transition do not necessarily have a comprehensive understanding of the complex system of the home (Holden, Schubert, Eiland et al., 2015). Further, our results suggest that current discharge instructions, tools, and processes do not yet acknowledge these key differences. The home, however, is not just a different setting; it also implies the transfer of the burden of care and responsibility for setting up routines and handling the workload demands associated with daily living, including shopping for food, acquiring medications, and managing finances. We found that over time, older adults incorporated self-care and illness management into their daily lives, but in so doing they experienced new needs for resources, information, and support. Thus,

Figure 3. The performance-shaping factor themes mapped onto a Human Factors systems framework known as the Systems Engineering Initiative for Patient Safety.

unlike one-time instructions, tools to support older adults during hospital-to-home transitions should adapt to changing needs that occur across transition phases. To assist the development and use of these interventions, Human Factors offers tools for measuring process workflow and work activity, methods recently demonstrated for assessing the daily activities of older adults over time (Chung, Ozkaynak, & Demiris, 2017). Future studies of transition workflow should more closely examine our finding of four transition phases and elucidate the timing of these stages, including both duration and whether they occur linearly or in cycles.

We found that during the hospital-to-home transition process, older adults experienced varying levels of workload, defined elsewhere as “all the demands in patients’ lives, including everyday responsibilities alongside the demands of patienthood all of which impact complexity through their toll on patients’ time, effort and attention” (Shippee, Shah, May, Mair, & Montori, 2012). One evident type of demand was related to self-care, reported by others as the burden of self-care learning, coordination, and integration (Gallacher, May, Montori, & Mair, 2011). However, our results also pointed to demands such as caring for others and arranging resources such as transportation. Others have noted that patient demands include job, family, travel and transportation, childcare, scheduling and attending clinical appointments, preventative care, self-education, self-care, taking medications, health behaviors, caregiving for others, and paperwork. Much of this work is “invisible” to others and therefore at risk of being overlooked (Ancker et al., 2015). Thus, future research and practice could assess and track patient burden over time, using emerging measurement tools (Eton et al., 2017).

Importantly, not only did demands fluctuate but so did individuals’ capacity to handle these demands. Thus, future work should focus as much on capacity as on patient demands or “burden.” Such work could address how the transition of responsibility from formal caregivers to patients and informal caregivers might be accompanied by better equipping or training the latter to handle the new responsibilities. Further, interventions could address social and community support networks and their role in alleviating transition-related burden through, for example, meal delivery, affordable caregiving services, or financial support through community-based and governmental (e.g., area agency on aging) organizations. Yet, other interventions could include the use of patient- or clinician-facing tools to assess and manage transition workload.

Limitations

Several limitations of this study should be considered. First, this study focused on the perspectives of older adults and we did not interview other key stakeholders involved in transitions, such as community pharmacists or primary care physicians. Second, interviews were conducted in one geographical area and may not be representative of all

older adults’ experiences. Third, the themes of this analysis were purposely broad, and future work should examine each theme more closely, for example, a full exposition on how demands and capacity change with time and the specific effects of instances of overload. We also acknowledge that our sample was educated and represented individuals from only two racial/ethnic groups; their experiences may not represent those of older adults from different racial/ethnic groups or educational experiences. Finally, as this was a secondary analysis, we were unable to confirm our themes and consequences with the study participants.

Designing Hospital-to-Home Transition Interventions Through a Systems Lens

During hospital-to-home transitions, the burden of care shifts to the older adult and informal caregivers, who may not always have the skills or capacity to facilitate successful transitions (Wolff, Meadow, Weiss, Boyd, & Leff, 2008). Our results suggest a gap between transitional self-care as it is performed by the older adult versus as imagined in discharge instructions. The mismatch between reality and ideal should be instructive to those developing or implementing discharge procedures. First, interventions should expand the discharge process beyond the days leading up to discharge. Discharge planning and support should extend from early in the hospital stay to weeks after discharge. Discharge planning should also query older adults concerns’ and potential barriers to self-care when returning home, using, for instance Holden and colleagues’ heart failure self-care barriers scale (Holden, Schubert, Eiland et al., 2015). Further, family caregivers must be included in these conversations, as they are often key actors in the hospital-to-home transition work. Health care providers, including social workers and/or case workers must be provided with actionable ways to address nonmedical concerns and barriers such as transportation needs or food insecurity. The extension of the concept of the hospital-to-home transition process also necessitates better connections between hospital providers, providers in the community, and community organizations. An example of this is the concept of navigators who work with multiple inpatient, outpatient, and community organizations during the transition (Manderson, McMurray, Piraino, & Stolee, 2012). Overall, closer attention to the PSFs and their dynamics over the hospital-to-home transition process will improve outcomes by better accommodating the reality of older adults’ transitions.

Funding

This work was supported by grants from the National Institute on Aging (NIA) of the US National Institutes of Health (NIH) (K01AG044439, PI: Holden) and grants UL1 TR000445 and KL2 TR000446 from the National Center for Advancing Translational Sciences (NCATS/NIH) through the Vanderbilt Institute of Clinical and Translational Research (VICTR). Participant recruitment was

supported by the National Heart, Lung, and Blood Institute (NHLBI; R01 HL109388, PI: Kriplani). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Acknowledgments

The authors would like to acknowledge the patient, caregiver, and clinician participants in this study and the Caring Hearts and Vanderbilt Inpatient Cohort Study research teams.

Conflict of Interest

None reported.

References

- Ancker, J. S., Witteman, H. O., Hafeez, B., Provencher, T., Van de Graaf, M., & Wei, E. (2015). The invisible work of personal health information management among people with multiple chronic conditions: Qualitative interview study among patients and providers. *Journal of Medical Internet Research*, *17*, e137. doi:10.2196/jmir.4381
- Anderson, G., & Horvath, J. (2004). The growing burden of chronic disease in America. *Public Health Reports (Washington, D.C.: 1974)*, *119*, 263–270. doi:10.1016/j.phr.2004.04.005
- Arbaje, A. I., Kansagara, D. L., Salanitro, A. H., Englander, H. L., Kriplani, S., Jencks, S. F., & Lindquist, L. A. (2014). Regardless of age: Incorporating principles from geriatric medicine to improve care transitions for patients with complex needs. *Journal of General Internal Medicine*, *29*, 932–939. doi:10.1007/s11606-013-2729-1
- Carayon, P. (2006). Human factors of complex sociotechnical systems. *Applied Ergonomics*, *37*, 525–535. doi:10.1016/j.apergo.2006.04.011
- Carayon, P. (2016). *Handbook of human factors and ergonomics in health care and patient safety*. Boca Raton, Florida: CRC Press.
- Chung, J., Ozkaynak, M., & Demiris, G. (2017). Examining daily activity routines of older adults using workflow. *Journal of Biomedical Informatics*, *71*, 82–90. doi:10.1016/j.jbi.2017.05.010
- Coleman, E. A. (2003). Falling through the cracks: challenges and opportunities for improving transitional care for persons with continuous complex care needs. *Journal of the American Geriatrics Society*, *51*, 549–555. doi:10.1046/j.1532-5415.2003.51185.x
- Coleman, E. A., & Berenson, R. A. (2004). Lost in transition: Challenges and opportunities for improving the quality of transitional care. *Annals of Internal Medicine*, *141*, 533–536. doi:10.7326/0003-4819-141-7-200410050-00009
- Council, N. R. (2011). *Health care comes home: The human factors*. Washington, DC: National Academies Press.
- Creditor, M. C. (1993). Hazards of hospitalization of the elderly. *Annals of Internal Medicine*, *118*, 219–223. doi:10.7326/0003-4819-118-3-199302010-00011
- Eton, D. T., Yost, K. J., Lai, J. S., Ridgeway, J. L., Egginton, J. S., Rosedahl, J. K., ... Anderson, R. T. (2017). Development and validation of the Patient Experience with Treatment and Self-management (PETS): A patient-reported measure of treatment burden. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation*, *26*, 489–503. doi:10.1007/s11136-016-1397-0
- Fernandez, H. M., Callahan, K. E., Likourezos, A., & Leipzig, R. M. (2008). House staff member awareness of older inpatients' risks for hazards of hospitalization. *Archives of Internal Medicine*, *168*, 390–396. doi:10.1001/archinternmed.2007.87
- Forster, A. J., Murff, H. J., Peterson, J. F., Gandhi, T. K., & Bates, D. W. (2003). The incidence and severity of adverse events affecting patients after discharge from the hospital. *Annals of Internal Medicine*, *138*, 161–167. doi:10.7326/0003-4819-138-3-200302040-00007
- Gallagher, K., May, C. R., Montori, V. M., & Mair, F. S. (2011). Understanding patients' experiences of treatment burden in chronic heart failure using normalization process theory. *Annals of Family Medicine*, *9*, 235–243. doi:10.1370/afm.1249
- Granger, B. B., Sandelowski, M., Tahshjain, H., Swedberg, K., & Ekman, I. (2009). A qualitative descriptive study of the work of adherence to a chronic heart failure regimen: Patient and physician perspectives. *The Journal of Cardiovascular Nursing*, *24*, 308–315. doi:10.1097/JCN.0b013e3181a4be30
- Holden, R. J., Carayon, P., Gurses, A. P., Hoonakker, P., Hundt, A. S., Ozok, A. A., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: A human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, *56*, 1669–1686. doi:10.1080/00140139.2013.838643
- Holden, R. J., & Karsh, B. T. (2007). A review of medical error reporting system design considerations and a proposed cross-level systems research framework. *Human Factors*, *49*, 257–276. doi:10.1518/001872007X312487
- Holden, R. J., Schubert, C. C., Eiland, E. C., Storrow, A. B., Miller, K. F., & Collins, S. P. (2015). Self-care barriers reported by emergency department patients with acute heart failure: A sociotechnical systems-based approach. *Annals of Emergency Medicine*, *66*, 1–12, 12e.1. doi:10.1016/j.annemergmed.2014.12.031
- Holden, R. J., Schubert, C. C., & Mickelson, R. S. (2015). The patient work system: An analysis of self-care performance barriers among elderly heart failure patients and their informal caregivers. *Applied Ergonomics*, *47*, 133–150. doi:10.1016/j.apergo.2014.09.009
- Holden, R. J., Valdez, R. S., Schubert, C. C., Thompson, M. J., & Hundt, A. S. (2017). Macroergonomic factors in the patient work system: Examining the context of patients with chronic illness. *Ergonomics*, *60*, 26–43. doi:10.1080/00140139.2016.1168529
- Hollnagel, E., Kaarstad, M., & Lee, H. C. (1999). Error mode prediction. *Ergonomics*, *42*, 1457–1471. doi:10.1080/001401399184811
- Horwitz, L. I. (2017). *Self-care after hospital discharge: Knowledge is not enough*. *BMJ quality & safety*, *26*, 7–8. doi:10.1136/bmjqs-2015-005187
- Jack, B. W., Chetty, V. K., Anthony, D., Greenwald, J. L., Sanchez, G. M., Johnson, A. E., ... Culpepper, L. (2009). A reengineered hospital discharge program to decrease rehospitalization: A randomized trial. *Annals of Internal Medicine*, *150*, 178–187.
- Jencks, S. F., Williams, M. V., & Coleman, E. A. (2009). Rehospitalizations among patients in the Medicare fee-for-service program. *The New England Journal of Medicine*, *360*, 1418–1428. doi:10.1056/NEJMsa0803563
- Karsh, B. T., Holden, R. J., Alper, S. J., & Or, C. K. (2006). A human factors engineering paradigm for patient safety: designing to

- support the performance of the healthcare professional. *Quality and Safety in Health Care*, 15 (Suppl. 1), i59–i65. doi:10.1136/qshc.2005.015974
- Karsh, B. T., Waterson, P., & Holden, R. J. (2014). Crossing levels in systems ergonomics: A framework to support 'mesoergonomic' inquiry. *Applied Ergonomics*, 45, 45–54. doi:10.1016/j.apergo.2013.04.021
- Kripalani, S., Jackson, A. T., Schnipper, J. L., & Coleman, E. A. (2007). Promoting effective transitions of care at hospital discharge: A review of key issues for hospitalists. *Journal of Hospital Medicine*, 2, 314–323. doi:10.1002/jhm.228
- Manderson, B., McMurray, J., Piraino, E., & Stolee, P. (2012). Navigation roles support chronically ill older adults through healthcare transitions: A systematic review of the literature. *Health and Social Care in the Community*, 20, 113–127. doi:10.1111/j.1365-2524.2011.01032.x
- Mansah, M., Fernandez, R., Griffiths, R., & Chang, E. (2009). Effectiveness of strategies to promote safe transition of elderly people across care settings. *JBIC Library of Systematic Reviews*, 7, 1036–1090. doi:10.11124/jbisrir-2009-206
- Murtaugh, C. M., & Litke, A. (2002). Transitions through postacute and long-term care settings: Patterns of use and outcomes for a national cohort of elders. *Medical Care*, 40, 227–236.
- Or, C. K., Karsh, B. T., Severtson, D. J., Burke, L. J., Brown, R. L., & Brennan, P. F. (2011). Factors affecting home care patients' acceptance of a web-based interactive self-management technology. *Journal of the American Medical Informatics Association: JAMIA*, 18, 51–59. doi:10.1136/jamia.2010.007336
- Rennke, S., Nguyen, O. K., Shoeb, M. H., Magan, Y., Wachter, R. M., & Ranji, S. R. (2013). Hospital-initiated transitional care interventions as a patient safety strategy: A systematic review. *Annals of Internal Medicine*, 158 (5 Pt 2), 433–440. doi:10.7326/0003-4819-158-5-201303051-00011
- Rennke, S., & Ranji, S. R. (2015). Transitional care strategies from hospital to home: A review for the neurohospitalist. *The Neurohospitalist*, 5, 35–42. doi:10.1177/1941874414540683
- Saldaña, J. (2015). *The coding manual for qualitative researchers*. London: Sage.
- Salvendy, G. (2012). *Handbook of human factors and ergonomics*. Hoboken, NJ: John Wiley & Sons.
- Sato, M., Shaffer, T., Arbaje, A. I., & Zuckerman, I. H. (2011). Residential and health care transition patterns among older medicare beneficiaries over time. *The Gerontologist*, 51, 170–178. doi:10.1093/geront/gnq105
- Shippee, N. D., Shah, N. D., May, C. R., Mair, F. S., & Montori, V. M. (2012). Cumulative complexity: A functional, patient-centered model of patient complexity can improve research and practice. *Journal of Clinical Epidemiology*, 65, 1041–1051. doi:10.1016/j.jclinepi.2012.05.005
- Werner, N. E., Gurses, A. P., Leff, B., & Arbaje, A. I. (2016). Improving care transitions across healthcare settings through a human factors approach. *Journal for Healthcare Quality*, 38, 328–343. doi:10.1097/JHQ.0000000000000025
- Werner, N. E., Malkana, S., Gurses, A. P., Leff, B., & Arbaje, A. I. (2017). Toward a process-level view of distributed healthcare tasks: Medication management as a case study. *Applied Ergonomics*, 65, 255–268. doi:10.1016/j.apergo.2017.06.020
- Wolff, J. L., Meadow, A., Weiss, C. O., Boyd, C. M., & Leff, B. (2008). Medicare home health patients' transitions through acute and post-acute care settings. *Medical Care*, 46, 1188–1193. doi:10.1097/MLR.0b013e31817d69d3
- Xie, A., & Carayon, P. (2015). A systematic review of human factors and ergonomics (HFE)-based healthcare system redesign for quality of care and patient safety. *Ergonomics*, 58, 33–49. doi:10.1080/00140139.2014.959070