

# Drivers of Health Information Exchange Use During Postacute Care Transitions

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**M**ore than 4 million Medicare patients are discharged to a skilled nursing facility (SNF) annually; these patients tend to be older, have more complex conditions, and are a significant driver of healthcare spending.<sup>1,2</sup> Weak transitional care practices between hospitals and SNFs compromise quality and safety outcomes for this population.<sup>3-6</sup> In response, numerous payment and delivery system reforms target this transition and create incentives for hospitals and SNFs to collaborate on improvement initiatives.<sup>7</sup> A key contributor to poor hospital–SNF transitions is the lack of robust information-sharing infrastructure between these settings, often resulting in missing, delayed, or difficult-to-use information received by SNF providers.<sup>8-11</sup> These deficits result in worse patient outcomes in SNF settings (eg, delayed care responsiveness, medical errors) and increased risk of rehospitalization.<sup>12-14</sup>

Electronic health information exchange (HIE) may help address deficiencies in hospital–SNF information sharing. HIE infrastructure has matured under the Health Information Technology for Economic and Clinical Health Act, with corresponding organizational and regional investments to improve communication and integration across care settings.<sup>1,8,15</sup> There is, however, significant uncertainty about if and how HIE supports hospital–SNF transitions, with very little empirical work examining use of HIE by SNFs.<sup>16</sup> Understanding what effective HIE looks like in this context is unique, as hospital and SNF providers may prioritize collection of different types of information. For example, SNFs focus on continuity in rehabilitation therapies and improvements to functional status, which are not points of emphasis during an acute hospitalization. Further, hospitals and SNFs also maintain different staffing models, workflows, reimbursement structures, and cultural norms; these discrepancies may increase the difficulty of constructing shared handoff processes that fit the needs and preferences of both organizations.<sup>17,18</sup>

Identifying factors associated with when and why postacute providers choose to access available HIE functionality will help assess whether current HIE infrastructure is meeting the needs of SNFs and what design or implementation changes could be made to maximize potential value. Therefore, in this study, we used a mixed-methods approach to answer the following research questions: (1) When

## ABSTRACT

**OBJECTIVES:** To characterize the drivers of the use of electronic health information exchange (HIE) by skilled nursing facilities (SNFs) to access patient hospital data during care transitions.

**STUDY DESIGN:** Explanatory, sequential mixed-methods study. Quantitative data from an audit log captured HIE use by 3 SNFs to retrieve hospitalization information for the 5487 patients discharged to their care between June 2014 and March 2017, along with patient demographic data. Qualitative inquiry included 16 interviews at the discharging hospital and HIE-enabled SNFs.

**METHODS:** Multivariate probit models determined patient-level factors associated with SNF HIE use. These models informed subsequent in-depth, semistructured interviews to refine our understanding of usage patterns, as well as facilitators of and barriers to use.

**RESULTS:** HIE was used by SNFs for 46% of patients for whom it was available; 29% of patients had records accessed within 3 days of hospital discharge. Overall HIE use was more likely for new versus returning SNF patients (3.8%;  $P < .001$ ) and when a patient was discharged from the emergency department rather than an inpatient unit (6.8%;  $P = .027$ ). HIE use was less likely on weekends (–4.3%;  $P = .036$ ) and for more complex patients, as measured by length of stay (–0.4% per day;  $P \leq .001$ ) or number of conditions (–0.3% per diagnosis;  $P \leq .001$ ). Interviews revealed distinct HIE use cases across SNFs; perceiving ability to access information not otherwise available in paper discharge materials, as well as workflow integration, were critical facilitators of use during transitional care.

**CONCLUSIONS:** HIE between hospitals and SNFs is underused. A mixed-methods approach is critical to understanding and explaining variation in implementation and use. Creating value requires hospitals and SNFs to codevelop system design, usage guidelines, and workflows that meaningfully integrate HIE into care delivery.

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## TAKEAWAY POINTS

- ▶ Despite substantial health information exchange (HIE) investment, there has been minimal focus regarding what value-generating HIE looks like to support transitions between hospitals and skilled nursing facilities (SNFs).
- ▶ This novel mixed-methods study explores what prompts SNF providers to utilize available HIE functionality and assesses barriers to effective use.
- ▶ HIE tools are currently underused to support postacute care transitions; usage patterns vary significantly across SNFs within a single community.
- ▶ Community-based hospital–SNF collaborations are critical for codeveloping clear guidelines that promote impactful usage practices; policy efforts can advance system design and processes that enable transfer of data elements specific to the needs of SNF providers.

available, to what extent is HIE used to support postacute transitions?  
 (2) What patient- and encounter-level factors are associated with variation in whether HIE was utilized during a patient's transition?  
 (3) What SNF organizational factors facilitate or hinder integration of HIE with existing transitional care practices?

## METHODS

## Setting

Our study examined hospital–SNF HIE between a large academic medical center and 3 local SNFs. In June 2014, the hospital extended a “view-only” HIE portal feature (EpicCare Link) to enable these SNFs to access hospital records for patients discharged to their facility. These SNFs receive the highest volume of the hospital's discharges to SNF—together, nearly 45% of total referrals. Administrators, nursing directors, and, occasionally, nurse unit managers were granted access. SNF physicians had full access to the hospital electronic health record (EHR) and therefore did not require portal access. This portal access was in addition to standard discharge protocol, which included a paper discharge summary and nurse-to-nurse phone call.

## Data: Quantitative

For all hospitalized patients discharged to any of the 3 HIE-enabled SNFs between June 2014 and March 2017, we pulled the following fields from hospital EHR data: patient medical record number, hospital admission and discharge time stamps, basic demographics, reason(s) for hospitalization, diagnoses, medications, and name of SNF to which the patient was discharged. We then merged these data with the audit file of all portal log-ins by users whose access rights were associated with an HIE-enabled SNF. These records are time-stamped and associated with a facility identifier, provider identifier, and medical record number of the patient whose information is being accessed. This study was approved by the health system Institutional Review Board (ID: HUM00123359).

## Measures

**Outcome.** Our primary outcome of interest is whether a SNF used the portal to access hospital information for a patient discharged to its

care. We used time stamps to calculate the time elapsed from a patient's hospital discharge to any recorded portal log-ins. We then created 2 binary indicators. The first captures use within a *broad window* of postacute care delivery and takes a value of 1 if portal log-in took place within a 16-day window spanning from 48 hours before hospital discharge (window not to extend earlier than time stamp of inpatient admission) to 14 days post hospital discharge or until the time of subsequent hospital readmission, whichever occurred first. The second, narrower *transition window* indicator captures activity more directly

related to transitional care. This indicator takes on a value of 1 only if first use of the system falls between 48 hours prior to discharge and up to 72 hours following hospital discharge to a SNF.

**Factors associated with informational need.** We hypothesized that 2 patient-level factors would drive greater SNF information needs and therefore be associated with greater likelihood of portal use. The first is greater medical complexity, measured by age, length of hospitalization, reason for hospitalization, number of diagnoses, and number of medication classes present on the medication list. The second concept is patient familiarity to the provider, which we measured with a single binary indicator for whether a patient is a new or returning patient to the SNF to which they were discharged following the index hospitalization.

We hypothesized 2 additional encounter-level factors associated with degree of information needs. The first is the type of hospitalization that occurred prior to SNF admission, as discharges from an emergency department (ED) or observational unit often lack the designated discharge planning staff and more robust transitional care processes (ie, nurse-to-nurse handoff call, structured discharge documentation) of an inpatient unit.<sup>19</sup> The second set of encounter measures is whether the patient was discharged after hours (6 PM to 6 AM) and/or on the weekend, when staffing is reduced at both the hospital and nursing facilities.<sup>20</sup> During these times, hospital nursing staff may not have the bandwidth to make handoff phone calls. Similarly, SNF nursing managers or support staff may not be available to help make follow-up inquiries in response to information gaps.

## Data: Qualitative

We conducted interviews with individuals involved in discharge planning at the hospital and with administrators and nursing staff at the 3 SNFs initially enabled with portal access in 2014. We also conducted interviews at 1 additional local SNF that received portal access in 2017. Interviews took place in February and March 2018; they were conducted in person and recorded, then transcribed. Hospital interviews were all conducted one-on-one, and SNF interviews were conducted in a group setting, with a minimum of 2 respondents per facility. Speaking with multiple respondents per site provided a range of perspectives based on role (ie, clinical vs administrative) and organizational tenure. Interviews lasted 30 to 60 minutes. Respondents

were asked to reflect upon factors that drive variation in perceptions of unmet informational need during care transitions, motivation to use the portal versus other mechanisms of information retrieval, and ease or difficulty of using the portal to support postacute care delivery. The protocol was designed to explicitly probe respondents on perceptions of portal use and usefulness in response to each of the patient- and encounter-level drivers of informational need identified and tested in the initial quantitative analyses. (See [eAppendix](#) [available at [ajmc.com](#)] for full protocol.)

### Analytic Approach

We used an explanatory sequential mixed-methods design. First, we generated descriptive statistics of HIE use across all SNFs and by individual facility. Key descriptive measures included patient-level system access rate (overall and by year), average time to first view of the HIE system (relative to hospital discharge), and percentage of sessions initiated within the transition window defined above. We then conducted bivariate analyses that compared descriptive statistics on all patient-level “informational need” covariates described previously across HIE-use and non-HIE-use patients. Finally, we ran pooled multivariate probit models with SNF-level fixed effects to regress HIE use on all patient-level covariates identified as significant from the bivariate analyses. We ran separate models for broad versus transition window use outcomes.

We approached our interview data using grounded dimensional analysis to deconstruct interactions and interpret meaning in a complex social situation.<sup>9,21</sup> We sought to discern patterns of HIE use within and across SNFs and to refine our interpretation of the effects of drivers of informational need identified during preliminary quantitative analysis. For the latter, we first developed provisional codes to identify domains of information needs in postacute care delivery.<sup>22,23</sup> We then applied codes to capture explicit and intuited reasons for variation in when providers experienced unmet informational needs; these drivers were identified a priori based on drivers of HIE use identified in the audit log analysis, with additional inductive coding of concepts outside the identified categories. Finally, we applied technology codes when respondents described examples of using information technology (IT) to solve identified informational problems, with separate codes for whether specific aspects of IT design or implementation enhanced or hindered the consequences of its use.

## RESULTS

### Quantitative Results

Our final quantitative data set contained 5487 hospitalized patients discharged to any of the 3 HIE-enabled SNFs between June 2014 and

**TABLE 1.** Descriptive Statistics of HIE Use: Pooled and Facility Specific

	Pooled	SNF A	SNF B	SNF C
Number of patients discharged to SNFs	5487	1586	2397	1504
Total number of patients (% of total patients) with portal use within broad window (2 days before to 14 days after hospital discharge)	2525 (46.0%)	766 (48.3%)	1194 (49.8%)	565 (37.6%)
Use, 2014	42.8%	8.3%	49.8%	36.0%
Use, 2015	54.3%	43.2%	48.6%	36.6%
Use, 2016	69.0%	78.9%	48.4%	50.0%
Use, 2017	66.1%	75.7%	66.0%	49.3%
Mean (SD) time to first portal use in days	3.1 (4.6)	7.4 (3.9)	0.7 (3.3)	2.2 (3.4)
Total number of patients (% of total patients) with portal use within transition window (2 days before to 3 days after hospital discharge)	1585 (28.9%)	148 (9.3%)	1052 (43.9%)	385 (25.6%)
Patients for whom transition window use occurred before hospital discharge	75.4%	60.8%	85.3%	54.3%

HIE indicates health information exchange; SNF, skilled nursing facility.

March 2017. Summary demographic information of this population is reported in [eAppendix Table 1](#). During this time frame, we observed 2525 patients for whom there was corresponding HIE use in the defined 16-day broad window, representing an overall access rate of 46.0% (range, 37.6%-49.8%) ([Table 1](#)). Two SNFs experienced increased rates of system use over time, whereas the third saw usage drop. The access rate during the transition window was 28.9% (range, 9.3%-43.9%). The average “time to first look” for patients in SNF A was 7.4 days post hospital discharge (well beyond the window of handoff), compared with SNF B (0.7 days post discharge) and SNF C (2.2 days post discharge). A significant amount of transition window use occurred prior to the patient leaving the hospital, ranging from 54% in SNF C to 85% in SNF B.

Bivariate results are reported in [eAppendix Table 2](#). In our multivariate analyses ([Table 2](#)), predicting any portal use in the broad window, the portal was less likely to be used for more complex patients, contradicting our hypothesis. Both a longer length of index hospitalization and greater number of active diagnoses on the problem list were associated with reduced likelihood of HIE use (−0.4% per day of hospitalization; −0.3% per additional diagnosis; both  $P < .001$ ).

Supporting our hypothesis, patients were more likely to have associated HIE use when they were new rather than returning SNF patients (3.8%;  $P = .001$ ) and when the SNF stay was preceded by an ED or observational stay rather than inpatient hospitalization (6.8%;  $P = .027$ ). Our findings regarding night and weekend discharges were contrary to our expectations. Patients discharged on a weekend were less likely to have HIE used for their care (−4.3%;  $P = .036$ ); nighttime discharges were associated with 4.7% lower likelihood of HIE use but with only marginal significance ( $P = .09$ ).

Similar patterns held for the relationships between patient/encounter characteristics and HIE portal use during the transition window. Greater case complexity was associated with reduced likelihood of portal use (−0.5% per extra day of hospitalization; −0.5% per additional medication class; both  $P < .001$ ). Being a new

**TABLE 2.** Association of Patient/Encounter Characteristics and Portal Use by SNF Providers: Pooled Multivariate Analyses

		Portal Use in Broad Window	Portal Use in Transition Window
Sample size		5487	5487
Driver of Informational Need	Specific Measure		
Medical complexity	Length of stay (days)	-0.004 (0.001)***	-0.005 (0.001)***
	Number of medication classes	0.001 (0.002)	-0.005 (0.001)***
	Number of conditions on current problem list	-0.003 (0.001)***	-0.0001 (0.001)
Degree of familiarity with patient	Patients who are new (vs returning) SNF residents	0.038 (0.012)***	0.006 (0.010)
Inadequacy of other information transfer mechanisms	Patients admitted to SNF following ED or observational stay only (vs inpatient)	0.068 (0.031)*	0.119 (0.025)***
Timing of transition and associated staffing levels	Nighttime discharge	-0.047 (0.028)	0.002 (0.024)
	Weekend discharge	-0.043 (0.021)*	-0.107 (0.020)***
Controls <sup>a</sup>	Age at discharge	0.0001 (0.001)	0.001 (0.001)
	Sex (male)	-0.003 (0.015)	0.002 (0.013)
R <sup>2</sup>		0.078	0.130
χ <sup>2</sup> test statistic, likelihood ratio test		411.3***	749.7***
Facilities (reference: SNF A)			
SNF B		0.226 (0.010)***	0.377 (0.014)***
SNF C		-0.056 (0.019)***	0.173 (0.014)***

ED indicates emergency department; SNF, skilled nursing facility.

\*P ≤ .05; \*\*P ≤ .01; \*\*\*P ≤ .001.

<sup>a</sup>Controls also include a binary indicator for each of the top 15 most common reasons for hospitalization.

SNF resident no longer had a significant association. An ED or observational stay was associated with an increased likelihood of transition window portal use (11.9%; *P* < .001), and a weekend discharge was associated with reduced likelihood of transition window portal use (-10.7%; *P* < .001); transition window HIE use was not associated with nighttime discharge.

**Qualitative Results**

We spoke with a total of 16 respondents (Table 3). Hospital respondents included an attending hospitalist physician, the director of the hospital case management and discharge planning team, and a hospital-employed care manager embedded at a local SNF. SNF respondents included a mix of facility administrators (n = 4), admissions staff (n = 4), directors of nursing (n = 3), and floor nursing staff (n = 2). Participating SNFs ranged in size, ownership, and complexity of populations served. Respondents characterized hospital-SNF handoffs as a complex set of workflows, with administrators, admissions staff, and floor nurses working together to cull necessary patient information from different information sources. SNFs discussed adoption and use of the portal within this context of information gathering already occurring via the paper discharge summary, phone calls with hospital nursing staff, and direct patient assessment upon transfer. SNF staff received no training and little instruction regarding how the portal could or should be used to complement these other processes, leading to significant variation in how the portal was used, users' experiences with the portal, and users' perceptions of utility.

Portal users in SNF A were primarily billing staff, using the system to retrieve patient information for Medicare and other payers' documentation requirements. SNF B used the portal primarily to facilitate information gathering about a patient prior to the patient being discharged into SNF care. The core portal users at this facility were nurse liaisons employed by the SNF who worked in the hospital to engage with patients, family members, and hospital providers prior to transfer. SNF C also tended to access patients' information prior to or immediately after physical arrival, but this use was driven by the nurse managers and director of nursing to get a head start on preparing appropriate resources (eg, tube-feeding recipes, oxygen, isolation authorizations) to accommodate patient needs. Finally, SNF D—for which we did not have audit log files that captured system use—reported use of the portal to retrieve complexity/risk scores for every admitted patient. The director of nursing described use as part of a systematized process for establishing patient care plans and appropriate level of services. Importantly, SNF D perceived use of the portal prior to SNF admission as a privacy violation and accessed information via the portal only after the patient physically entered the facility.

We also gained insights into the mechanisms underlying observed associations between hypothesized drivers of informational need (from our quantitative results) and HIE use to support transitional care:

**(1) Patient complexity.** SNF respondents felt that increased complexity was associated with greater uncertainty regarding care needs and prompted greater HIE use. In particular, respondents used the portal to seek out more detailed information on social

**TABLE 3.** Qualitative Data Collection: SNF Organizational Characteristics and Summary of Portal Use

	Size Range (beds) <sup>a</sup>	Patient Complexity <sup>b</sup>	2017 Adjusted Rehospitalization Rate, Short-Stay Residents (<101 days)	Ownership	Date of Portal Activation	Primary Portal Users	Primary Information Sought	Reported Timing of Use
SNF A	100-199	Medium	23%	Not-for-profit	6/2014	Billing/Medicare documentation team	Information for reporting requirements	Several days post transition
SNF B	100-199	High	22%	For-profit	6/2014	Pre-SNF admission nurse liaison (SNF employed; works in the hospital)	Information to assess SNF ability to accept a patient (prior to transition)	1-4 days pretransition
SNF C	50-99	High	27%	For-profit	6/2014	SNF nurse managers; director of nursing	Information to prepare patient room and services when arrival is imminent	Within 24 hours before or after transition
SNF D	>199	Medium	20%	Not-for-profit	9/2017	Director of nursing	Information regarding patient complexity score at hospital discharge	Immediately post transition

SNF indicates skilled nursing facility.

<sup>a</sup>Size categorization based on ranges used by CMS.

<sup>b</sup>Complexity categorization based on average hierarchical condition category risk score, percentage of patients who are dually eligible, and length of stay.

history and needs for complex patients. At the time of receiving a patient post discharge, SNF respondents reported that information elements related to a patient's social determinants—such as nature of family support or food and housing security, as well as behavioral risk factors—were rarely made available in the paper discharge documentation. However, this information was also not accessible through the portal. The hospital case manager confirmed that this information would typically be housed within social work documentation and nursing notes, but these areas of the hospital EHR are restricted from portal view.

When we shared our findings that medical complexity was associated with lower HIE use, respondents noted that more difficult-to-treat patients tended to have more intensive involvement in their care from the on-site subacute physician team members, who were employed by the hospital. The presence of these physicians in the SNF created a parallel pathway into the hospital's records, because these doctors completed their charting via full, direct access into the hospital's EHR. Thus, SNF nurses noted that they often—especially for a more complex patient—would ask an on-site doctor or advanced care practitioner to make record inquiries on their behalf.

**(2) Patient familiarity.** SNF respondents largely did not perceive differences in informational needs for new versus returning patients, at least in addressing care needs stemming from the most recent hospitalization. HIE was, however, reportedly often used to gain better access to longitudinal records of patient care, such as to identify a history of falls and fractures. Access to this information was more critical for new patients, although not always time sensitive in the context of handoff. These anecdotes help to explain our quantitative finding that being a new patient at a SNF is positively associated with overall HIE use but not use during the transition window.

### **(3) Inadequacy of other information transfer mechanisms.**

Hospital respondents described paper discharge summaries as fairly consistent (due to embedded EHR modules) across providers and units but with significant variation in the timing of when this final discharge process was completed. SNF respondents were acutely aware of this issue. SNFs described challenges with patients' discharge summaries and instructions sometimes arriving 6 to 24 hours post transfer and experiencing greater need to use the HIE portal in these scenarios. These delays were perceived by SNFs to be caused by backups and workflow hiccups at the hospital. Respondents thought it plausible but could not confirm whether these issues were more likely when patients had been discharged to their facility from the ED or an observation bed (rather than inpatient units, a finding from our quantitative analyses).

**(4) Weekend discharges.** Portal use was greatly restricted on evenings and weekends when administrators and senior nursing staff—the only SNF staff with portal access rights—were not on site. Whereas we hypothesized that reduced staffing at both the hospital and SNF would drive up need for HIE to fill in informational gaps during these times, key organizational constraints (staffing models, management structure, and existing workflows) prevented portal use in this context.

## **DISCUSSION**

In an analysis of 1 large academic hospital adopting an information exchange portal to share transitional care information with local SNFs, we find that these tools are underused. The portal was never accessed for more than half of all patients for whom it was available, and it was used just 29% of the time in the time frame surrounding

handoff. Our mixed-methods approach offered a critical, underused opportunity to understand what really drives observed variation in when and how health IT is used to support care delivery. Our findings, which identify specific factors that impede the types of use that could meaningfully improve both provider and patient experience, underscore the importance of this approach and its usefulness in future research.

Our results demonstrate that SNF portal use was driven in part by contextual factors that heightened informational needs, such as lack of familiarity with a patient or referrals from hospital units with less robust paper discharge documentation. But, surprisingly, use was less likely in contexts where real-time electronic information retrieval could offer unique value, such as caring for particularly complex patient populations or managing transitional care when handoff occurs outside of traditional business hours. This suggests that current HIE infrastructure may not be delivering the value necessary to motivate SNF providers to incorporate system use into existing workflows. Indeed, qualitative inquiry reveals that nursing and social work documentation from the hospital is critical to supporting postacute care delivery but is often unavailable or difficult to access via the portal.

Our findings also reveal that HIE use is constrained by implementation issues such as limited system access rights and vague usage guidelines for when and how the portal could be used. In the absence of strategic direction from the hospital, we observed significant variation in portal usage patterns across enabled SNFs. SNFs and hospitals need to work together to develop policies that clearly articulate what types of information retrieval and use cases are possible and clarify around when the system can be used. Forming or strengthening community collaboratives provides an ideal opportunity to engage across organizations in this type of quality improvement initiative.<sup>24</sup> Further, additional guidance at the federal level may be required to clarify Health Insurance Portability and Accountability Act concerns and ensure consistent data-sharing practices across organizations.

Hospitals and SNFs are increasingly considering electronic information sharing as a strategy to strengthen coordination and transitional care quality under payment reform.<sup>7</sup> These findings have important implications for understanding the role that HIE-mediated information transfer can and perhaps should play in the greater context of information continuity during hospital–SNF handoffs. Current patterns of HIE use by SNFs should not be expected to drive significant improvements in care. Changing this projection requires adopting a sociotechnical perspective on improving care processes.<sup>25</sup> Hospitals need to engage more actively with SNFs to understand information needs in this setting and organizational constraints (ie, staffing structures, workflows) that challenge care continuity. Hospitals should keep these factors in mind when adapting their technical infrastructure—for example, a more customized portal interface or summary page for postacute care providers—to make relevant information more accessible and extract value from HIE investments. Policy makers can support these efforts by requiring

key nursing and social work data elements in continuity of care documentation and summary of care records generated by certified EHRs. SNFs also need to consider their structural limitations and revisit workflow design to better connect those with information retrieval capabilities to the timely needs of floor nurses with direct patient care responsibilities, as well as consider how to leverage portal access to complement existing information transfer via other means. These workflows can and should evolve as technical capabilities change.

### Limitations

Analyses were limited by the cross-sectional nature of the log-file data. However, we were able to leverage the explanatory sequential design of this study to further explore mechanisms underlying usage practices and explain quantitative results when tests of association were not directionally consistent with our hypotheses. Another key limitation is that data came from a single hospital and a subset of SNFs in the same local community that use 1 specific approach to HIE (a portal). This limits generalizability. However, the hospital uses a dominant commercial EHR system and has significant market power and advanced resources to support postacute transitions, suggesting that our setting represents a current best-case scenario for hospital–SNF HIE capabilities. This context enabled identification and deeper understanding of key challenges likely to be relevant to many other care settings as they explore use of electronic information sharing to support postacute transitions of care.

## CONCLUSIONS

Electronic HIE is perceived to have great potential to facilitate information sharing that would improve postacute care transitions. Realizing these benefits requires modifications to HIE system design and information accessibility, complemented by thoughtful restructuring of enabling organizational workflows in the SNF setting. This could be facilitated by community-based hospital–SNF collaboration mechanisms and active policy efforts to promote care transition processes that more explicitly incorporate data elements specific to the needs of SNF providers. ■

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**eAppendix Table 1.** Demographics of Patients Discharged to HIE-Enabled SNFs, 2014-2017

No. of patient encounters	5487
Age	69.7 (14.2)
% Male	45.7%
% White	78.6%
Avg. length of hospital stay	10.3 (12.8)
Number of diagnoses	20.4 (9.2)
30-day readmit rate	28.4% (45.1)
Time until readmission	10.4 (7.5)
Average length of readmission stay	5.6 (7.4)
14-day readmit rate	19.8% (39.9)
7-day readmit rate	11.7% (32.1)



**eAppendix Table 2A.** Patient Drivers of HIE Portal Use, by Facility (Bivariate Analyses)

<b>Driver of Informational Need</b>	<b>Specific Measure</b>	<b>No HIE Use N=2,962</b>	<b>Any HIE Use N=2,525</b>	<b>T-test difference in means (P-value)</b>
Medical Complexity	Length of stay (days)	11.5 (15.4)	8.7 (8.6)	<0.001
	Number of conditions on current problem list	21.5 (9.3)	19.2 (8.8)	<0.001
	Number of medication classes	9.5 (5.1)	9.4 (5.2)	0.597
Degree of Familiarity with Patient	Patients who are new (rather than returning) SNF residents	81.4%	89.2%	<0.001
Inadequacy of other information transfer mechanisms	Patients admitted to SNF following ED or observational stay only (compared to inpatient)	5.6%	12.4%	<0.001
Timing of transition (and associated staffing levels)	Nighttime discharge	16.1%	15.5%	0.558
	Weekend discharge	14.7%	11.6%	0.001
Controls	Age at discharge	69.2 (14.2)	70.3 (14.2)	0.005
	Gender	45.6%	45.7%	0.946
	Non-white race	21.6%	21.2%	0.710

**eAppendix Table 2B.** Patient Drivers of HIE Portal Use, by Facility (Bivariate Analyses)

<b>Driver of Informational Need</b>	<b>Specific Measure</b>	<b>First HIE Use after transition window N=940</b>	<b>First HIE Use during transition window N=1,585</b>	<b>T-test difference in means (P-value)</b>
Medical Complexity	Length of stay (days)	8.0 (8.0)	9.0 (5.2)	0.001
	Number of conditions on current problem list	18.2 (8.3)	19.9 (9.0)	<0.001
	Number of medication classes	10.0 (5.1)	9.0 (5.2)	<0.001
Degree of Familiarity with Patient	Patients who are new (rather than returning) SNF residents	92.8%	86.8%	0.001
Inadequacy of other information transfer mechanisms	Patients admitted to SNF following ED or observational stay only (compared to inpatient)	13.3%	11.9%	0.312
Timing of transition (and associated staffing levels)	Nighttime discharge	10.7%	18.4%	0.000
	Weekend discharge	16.7%	8.6%	<0.001
Controls	Age at discharge	73.7 (13.9)	68.3 (13.9)	73.7 (13.9)
	Gender (Male)	42.3%	47.7%	42.3%
	Non-white race	20.1%	21.9%	20.1%

## eAppendix Protocol

### A. Interviewee and Practice Demographics

1. Please describe your current role(s) at [SNF XX] and how long you have been at this facility.
  - a. Did you previously serve in a different role here or at another local SNF?
2. [*administrator only*] Can you tell me some general details about this facility, including:
  - a. Average percent of patient population admitted from the University hospital?
  - b. The nature of physician coverage?
  - c. The number of personnel and composition of a typical care team for a resident? (i.e. nurse, nursing aides, etc.)
3. What *clinical* electronic health record or other record keeping system(s) do you have in place at [SNF XX]? [*prompt: exclude databases related to human resources and financial administration*]
  - a. [for each electronic system(s) in place]
    - i. What is the name of this system?
    - ii. What are the primary functions of this system? (i.e. billing? Medicare quality reporting? Support for care delivery? Medication administration? Patient medical records?)
    - iii. When was it implemented? What did you have in place prior to this system?
    - iv. What prompted you to adopt this system?
  - b. Do you also maintain paper record systems?
    - i. To what extent do staff rely on paper versus electronic records?

### B. Patient Complexity and Process Variation

Before we get in to the specifics of patient handoffs and information transfer, I would like to understand the important ways in which your processes may vary across intakes based on certain patient characteristics.

4. Would you describe processes of intake and transitional care as standardized?
  - a. What policies/procedures guide these activities?
    - i. [*if relevant*] Did these policies change when [SNF XX] received access to Hospital records via EpicCare Link?
  - b. In what ways, if at all, are policies modified by staff? (Probe on consistent versus ad-hoc modifications)
5. Are there particular patient case characteristics that alter traditional care practices? [*we will probe on these as we walk through each step of patient care and information transfer*]
  - a. Classification by Resource Utilization Groups (RUGs)
  - b. Specific patient conditions?
  - c. Overall complexity?
    - i. If so, please define: number of conditions, any disabilities (physical or cognitive), medication combinations, frailty, etc.?
  - d. Type of hospitalization?
  - e. Timing of discharge (e.g., “off shift” as well as weekend)?

f. Other?

**C. Information Transfer from Hospital to SNF**

6. How would you define the “transition window” of care during which providers and staff are getting a patient settled in to the SNF and on a routine care plan?
7. What information retrieval, if any, takes place prior to accepting the patient?  
[probes if needed]
  - a. Who at [SNF XX] is involved in these arrangements?
  - b. What key data elements are being sought?
  - c. How is this information gathered (phone, in person, fax, electronic viewing)
  - d. Where is this information documented internally?
8. At the time a patient is discharged to [SNF XX] from the hospital, in what way(s) is that information sent to/received by [SNF XX]? (paper, fax, by phone, electronic viewing?)
  - a. Do you use more than one method of information retrieval?
9. What are the key information elements you are looking for from the hospital? (e.g. medication list, physician/nursing notes, discharge summary)
  - a. How does information seeking vary across different platforms or media used for information sharing (i.e. is there particular information that you seek by phone and other details that are found in the paper chart?)
  - b. How are these information elements incorporated in to your internal record(s)?
10. Does the documentation you receive from the hospital provide information you can use and understand?
  - a. Are there aspects of the documentation sought/retrieved from the hospital that *facilitate* you finding the information you need and/or incorporating it in to your records? (e.g. information ordering/prioritization, highlighting, summaries)
  - b. Are there aspects of the documentation sought/retrieved from the hospital that *create challenges* as you seek the information you need and/or incorporate it in to your records?
    - i. Missing information?
    - ii. Information overload?
    - iii. Timeliness of information receipt?
    - iv. Other?
11. What additional information seeking might occur after the transition window surrounding SNF admission has passed?  
[probes if needed]
  - a. When do these other information seeking processes tend to take place? What are they prompted by?
  - b. What methods are used to retrieve this information? Does method vary by type of information needed?
12. At each stage of information gathering, how (if at all) would processes differ based on the patient characteristics we discussed above?

**D. Information Retrieval Processes from other Hospitals**

13. To what extent do the processes of information retrieval look different for patients coming from hospitals other than Hospital XX? (*Probe on: timing, method(s) of information transfer, volume/relevance/accuracy of information received, ease of handoff*)
- Before hospital discharge
  - At the time of transition from hospital to SNF
  - During a patient's stay duration at **SNF XX**

**E. Targeted Questions Regarding ECL Use**

14. Were you employed at [SNF XX] when the facility started to access Hospital XX information through EpicCare Link (ECL)?
- (if yes) What training or resources were provided, if any, to guide use of this electronic information viewing system?
15. Overall, how would you characterize the extent to which your facility utilizes EpicCare Link?
- Has this use changed over time?
  - Do rates of use vary across staff at **SNF XX**?
  - Do all staff have equal access to ECL?
16. How would you describe the typical use case for ECL versus other methods for information retrieval?
- Standardized process vs. need-driven use
  - Does the specific nature of ECL use vary across staff at **SNF XX**?
17. Does ECL use vary based on any of the patient characteristics we initially discussed?
18. Based on analysis of the ECL usage data, I detect that your system is most often used in the following way [*describe/share facility-specific usage findings*]
- Does this fit with your understanding of typical system use?
  - Does this description surprise you?
  - Are there important aspects of system use not captured here that you think are important to understanding how **SNF XX** utilized ECL?
19. What do you think ECL does particularly well in supporting transitional and post-acute care?
20. What do you think could be improved in terms of use of ECL to support transitional and post-acute care?
- System design?
  - Workflow/processes?
  - Other?

**F. Wrap up**

Thank you for taking the time to speak with us today. Is there any additional information you think we should know related to your facility's systems and processes for retrieving information to support transitional and post-acute care delivery?