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Unrealistic Post-Surgical Expectation of Independence (UPSI) Predicts Complex Hospital Discharge

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Abstract

Background: Careful discharge planning for older surgical patients can reduce length of stay, readmission, and cost. We hypothesized that patients who *overestimate* their self-care ability prior to surgery are more likely to have complex post-operative discharge planning.

Materials and methods: The Vulnerable Elders Surgical Pathways and Outcomes Assessment (VESPA) is a brief pre-operative assessment that can identify older (age ≥ 70) patients with multidimensional geriatric risk, defined by all three of the following: (1) physical or cognitive impairment, (2) living alone, and (3) lack of handicap-accessible home. The VESPA also asks a novel post-operative self-care ability question, whether patient can independently provide self-care for several hours after discharge. Classifying patients into four groups based on multidimensional geriatric risk (full vs none/partial) and the self-care ability question (yes/no), we hypothesized those with *Unrealistic Post-Surgical expectation of Independence* (UPSI) (both fully at risk + “yes” to self-care ability question) would be at the elevated risk for complex discharge planning. Complex discharge planning was defined as prolonged stay due to nonmedical reasons or multiple changes in discharge plans.

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Results: In 382 hospitalizations of 2-days, 366 had a non-missing answer to the self-care question; of those 5% had UPSI and 6.3% needed complex discharge planning. The UPSI group was independently associated with greater risk of complex discharge planning compared to the Normal group (odds ratio=4.3 [95% CI: 1.1–16.1]).

Conclusions: Complex discharges were rare, but predictable by pre-operative geriatric screening. Patients with UPSI should be targeted for post-operative care planning in advance of surgery.

Keywords

geriatrics; pre-operative evaluation; discharge planning

Introduction

Effective hospital discharge planning plays a crucial role among older patients who are at risk of prolonged hospitalizations and higher costs compared to younger adults.^{1,2} Intensive discharge planning interventions that identify high-risk patients *after* hospital admission have been shown to reduce length of stay, rate of readmission, and costs.^{3–7} However, for patients with planned hospitalizations, namely those with upcoming elective surgeries, we asked the question whether or not we could identify high-risk patients prior to the surgical admission during the pre-operative evaluation. Identifying such a population could potentially lead to future interventions that could begin even earlier than the hospital admission, i.e., *prior* to admission.

In 2008–2011, we implemented the Vulnerable Elders Surgical Pathways and Outcomes Assessment (VESPA) tool on older patients in a pre-operative surgical clinic. The VESPA tool is a brief geriatric assessment that can predict post-operative surgical and geriatric complications.⁸ As part of the VESPA, we also interviewed patients using a novel self-efficacy question to assess their post-operative self-care ability: whether they were able to manage themselves alone for several hours after the surgery. For patients who answered “no” to this question, this novel item alone was highly effective at predicting post-operative surgical complications and geriatric occurrences such as delirium. However, we did not evaluate whether the patients’ self-assessments were realistic, given their situations. Therefore, we asked the question whether *unrealistic* expectations would contribute independently to the complexity of discharge planning process. In this current study we identified objectively-measured risk factors that should complicate the post-surgical discharge process: pre-operative functional, cognitive, or mobility impairment, living alone, and environmental barriers to home discharge. We then defined patients as having unrealistic expectations who thought they could care for themselves while their VESPA evaluation suggested otherwise. We hypothesized that the unrealistic patients would underestimate their post-operative care needs, and therefore participate less efficiently in discharge planning process, leading to a more protracted and complicated discharge planning experience (Figure 1, Conceptual Model).

Materials and methods

Study Design, Patient Population, and Setting

This is a prospective, observational study of older patients who underwent a quality improvement intervention, the VESPA evaluation.⁸ The VESPA was administered in a pre-operative surgical clinic in Michigan Medicine in patients ≥ 70 years old with upcoming elective surgery, including otolaryngology/oral maxillofacial, plastics, gastrointestinal, urologic, breast, ophthalmologic, thoracic, neurologic, orthopedic, and vascular surgery. The VESPA was performed by surgical physician assistants (PAs) on the same day of their routine pre-operative assessment from July 9, 2008 to January 5, 2011. We then obtained permission to perform a medical record and administrative data review to study whether the VESPA evaluation could predict post-operative complications and hospital discharge care process as outcomes (University of Michigan Institutional Review Board HUM00020657).

Of the original VESPA population (736 patients undergoing any planned surgical procedure), we limited this study of complex discharge to those with at least 2-day stay to allow opportunity for discharge planning to become complicated.

Sources of Data

We used results from the pre-operative VESPA evaluation which was comprised of: (1) functional status screen using 14 Basic/Instrumental Activities of Daily Living items (BADLs/IADLs);^{9,10} (2) cognitive screening (Mini-Cog Test);¹¹ (3) gait and mobility testing, including falls in the past year, Timed Up and Go (TUG) test,¹² and clinician-rated abnormal/unsteady balance; (4) home environmental risks (any stair to enter, no bathroom/bedroom on the first floor, and no handicapped equipment such as railing for stairs or grab bars in the shower/bath); and (5) a screen for living alone. In addition to the BADLs/IADLs, we also asked a novel self-efficacy question: whether the patient anticipated he/she was able to manage themselves for several hours alone after discharge. Interviews questions were asked of the patient and any caregivers present. On average, time required to administer VESPA by the PAs was <10 minutes. Results of the VESPA were recorded on paper; by design, the results did not enter the medical record or affect subsequent patient care. Age ≥ 70 years was the only other requirement; we had no further exclusions such as type of surgery.⁸

From December 11, 2012 to October 2, 2015, we conducted a medical record review of patients who had received the VESPA evaluation and underwent the planned surgery within 3 months. We reviewed hospital notes (doctor, physician assistant, social work/case manager, rehabilitation) and orders, collecting information relevant to discharge planning, including post-operative functional status, discharge location, family meetings regarding discharge decisions, and new post-operative functional impairments and nursing needs. The chart abstractor (author CC, who has advanced degree in clinical social work and is an experienced research assistant in health care outcomes research) compared results of evaluation with 10% stratified random sample (5% charts with and without complex discharge) with a second abstractor (author LM, clinical geriatrician and health outcomes researcher).

Lastly, from the medical record review we also collected comorbidity using the Charlson Comorbidity Index^{13,14} and from administrative data we linked cases to procedure codes and length of stay.

Measures

Outcome Variable: From abstracted hospital notes and orders, we coded all evidence of complexity of discharge planning, defining complex discharge planning as meeting either of two criteria: (1) Prolonged length of stay (by at least one day) due to non-medical reason (e.g., obtaining care, family teaching, nursing home placement and (2) Multiple communications between health care providers (doctors, social workers, nurses, or discharge planner) and the patient/family regarding discharge planning AND the discharge process included major/multiple changes in plan or difficult decisions.

Predictor variable of interest: The VESPA items were used to determine patients with *full multidimensional geriatric risk*, defined having risk in all three following domains:

- 1 geriatric impairment: functional difficulty (feeding, transferring, toileting, grooming, dressing, bathing, preparing meals, driving/transportation, grocery shopping, using the telephone, medication management, housekeeping, laundry, and handling finances), cognitive impairment (3 or fewer of 5 points on the Mini-Cog test), or gait and mobility impairment (either self-reported falls in the past year or abnormal gait or balance exam).
- Living situation: lived alone.
- Home environmental risk: absence of handicap modifications for a home with bed/bathroom on 2nd floor or higher or 1 stair to enter home.

Next, we combined full multidimensional geriatric risk with the self-efficacy question (answering yes/no to the post-operative self-care question) to identify four groups of patients that we hypothesized to be at increasing risk of complex discharge:

1. Normal: Not fully at risk and answered “yes” to post-operative self-care ability question.
2. Precautious: Not fully at risk and “no” post-operative self-care ability.
3. Realistic: Fully at risk and “no” post-operative self-care ability.
4. Unrealistic Post-Surgical expectation of Independence (UPSI): Fully at risk, yet answered “yes” to post-operative self-care ability.

In our conceptual model (Figure 1), patients in the UPSI group are confident about their ability to care for themselves post-operatively disproportionate to their functional or cognitive limitations, given that they lived alone and their home environment has not been modified for functional limitations. We hypothesized that UPSI patients would be less likely to pre-plan for their post-operative discharge needs such as functional and mobility limitation due to pain, new mobility or medical devices, wound care needs, or medical self-management requirements, and therefore would be more likely to have a complex discharge planning course than the normal group.

Co-variables: In multivariable models we controlled for age, surgical complexity, and multimorbidity. As a proxy measure to control for surgical complexity, we used Common Procedural Terminology (CPT) and International Classification of Disease, Ninth Revision (ICD-9) codes for each patient's primary procedure and matched each procedure with the Work-related Relative Value Unit (WRVU).¹⁵ A greater WRVU indicates greater risks and resources required to perform the surgery. To generalize for use in future clinical applications, we used the median WRVU value to categorize patients into two categories, high versus low-RVU group.

To further measure patient's medical complexity, we used the Charlson Comorbidity Index (CCI),^{13,14} a predictor of post-operative complications and mortality, using a cutoff of 2 points to capture greater multi-morbidity.¹⁶

Data Analysis

Data analysis was conducted from February 11, 2016 to July 14, 2018. We first compared characteristics between the exposure groups (Precautious, Realistic, UPSI, and Normal), using t-tests to compare means of age, and χ^2 test or Fisher's exact test (for cells with small size) to compare the proportions with high RVUs, multi-morbidity, and complex discharge. The normal was used as the comparison to the three abnormal groups. Next, we used logistic regression model to predict the effect of the four risk groups on complex discharge, controlling for age, high vs. low WRVUs, and multimorbidity. All statistical analyses were conducted using STATA version 13 (StataCorp LP).

Results

From July 9, 2008 to January 5, 2011, we performed 770 VESPA evaluations. Among these, 736 underwent the planned surgery. Four patients had two separate planned admissions for their surgeries, so there were 740 planned admissions we abstracted. Our study sample was 382 hospitalizations with at least 2-day stay (Appendix A). There were 16 who did not answer their ability to manage themselves alone after discharge, so 366 were included in the final data multivariable analysis on complete data.

Sample Characteristics (Table 1)

The mean age was 77.7 years and 51.8% were male. More than a quarter (27.2%) had a difficulty in 1 of the 14-item BADLs/IADLs. Up to 85.6% of the sample had at least one of the environmental risks around their home and 26.8% lived alone. Nearly 5.7% failed the Mini-Cog Test, and 40.1% was screened positive for a gait and mobility impairment. Of 366 patients who answered the post-operative self-care ability question, over half (53.8%) said "yes." Failing the Mini-cog test was not associated with the post-operative self-care ability question ($p=.31$). Among the 366 patients, 178 (48.6%) were classified as Normal group, 149 (40.7%) as Precautious group, 20 (5.5%) as Realistic group, and 19 (5.2%) as UPSI group.

The most common types of surgeries among this population were gastrointestinal (30.6%) and urologic (22.3%); and 67.3% of the surgeries were oncologic. Procedures within each of high versus low WRVU groups are provided in Table 2. The cutoff between high versus low

WRVU group was 15.85 RVUs. The mean of WRVU was 19.8 (± 11.8 , ranged from 0–52.84). The mean of the CCI score was 3.5 (± 2.3 , ranged from 0–14) and the most common comorbidities were tumor without metastasis (54.7%), diabetes (36.9%), chronic pulmonary disease (18.3%), and peripheral vascular disease (14.7%). The mean length of stay was 6.2 days (± 5.7 , ranged from 2–50).

Outcomes

Among the 366 patients, 23 (6.3%) had complex discharge planning, and among these patients, 20 patients met by multiple family meetings and/or multiple changes in discharge plans and 6 met criteria due to a non-medical reason that prolonged their length of stay (and 3 patients met by both criteria). The average number of prolonged days for these 6 patients was 2.2 (± 1.3 , ranged from 1–4). Of these 6 patients with prolonged stay, only 2 of them were in the UPSI group. The agreement between the two abstractors was 94.4% and kappa=0.89.

Comparing Characteristics of Risk Groups (Table 3)

In unadjusted analyses, we found that compared to patients in the Normal group, patients in the UPSI group were older (mean age=80.8 vs 77.0, $p=.004$), were more likely to have complex discharge planning (21.1% vs 5.6%, $p=.03$) and skill needs at discharge (79.0% vs 52.3%, $p=.03$), and to be discharged to a nursing home (26.3% vs 4.5%, $p<.001$); the Precautious group was also more likely to be discharged to a nursing home (12.1% vs 4.5%, $p=.01$) and had more deaths within 30 days of the surgery (3.4% vs 0%, $p=.02$); the Realistic group was less likely to be male (25.0% vs 59.6%, $p=.003$) and was more likely to be discharged to a nursing home (20.0% vs 4.5%, $p=.02$).

Effect of UPSI on Complex Discharge Planning

Table 4 shows that using a logistic regression model controlling for age, surgical complexity, and medical co-morbidity, the UPSI group was independently associated with greater risk of complex discharge planning compared to the Normal group (odds ratio=4.3 [95% CI: 1.1–16.1]).

Discussion

In this study, we developed a novel risk factor, Unrealistic Post-Surgical expectation of Independence (UPSI), which can be determined by the VESPA, a <10 minutes geriatric pre-operative assessment performed by surgical PAs during the course of a busy general pre-operative clinic. Among patients with at least a 2 hospital-day stay, a small number of patients (5% of the sample) in the UPSI group were 4 times more likely to have complex discharge planning compared to the patients in the Normal group.

This research extends what is previously known about patients' pre-operative expectations of self-care after their planned surgery. General self-efficacy¹⁷ (e.g., asking patients to rate the trueness of the statement, 'I can always manage to solve difficult problems if I try hard enough') is a burgeoning topic of research interest in surgery research. A prospective study of 223 elective hip replacement patients collected self-efficacy measures pre-operatively and

found that better self-efficacy predicted less pain, stiffness, and impairment after surgery.¹⁸ A study to predict post-operative readmissions at 4 VA medical centers is still ongoing, with plans to collect general self-efficacy at the time of discharge rather than preoperatively.¹⁹ In our original VESPA study⁸ nearly half of patients answered “no” to a question concerning self-assessed ability to manage oneself several hours alone after discharge, which was a strong predictor for post-operative complications, both general surgical (the typical complications measured by the National Surgical Quality Initiative Program)²⁰ and geriatric types of occurrences (namely, delirium).⁸ In this current study, our results suggest that among patients with multidimensional geriatric risk (having impairments in cognition or physical health and living alone in a home without handicap adaptation), answering “yes” to this same question has additional value to predict discharge complexity. In addition, the UPSI group had 4 times the proportion of complex discharges (21% vs 5%) compared to a small but similar at-risk group who had instead realistically answered “no”. Although we may have found this difference due to chance (small sample size Fisher exact test p-value = .18), this finding reinforces the utility of matching patient’s expectations of independence with their actual risk.

Our results suggest we have identified a small but outlying group of patients with the potential for complex discharge process that may be preventable. These patients had increased needs for skilled nursing in either a facility or at home due to physical impairment, wound care, or antibiotic therapy. While having nursing needs were increased for all patients who were predisposed to having impairment, such as those with pre-existing impairments (the realistic group), having pre-existing impairments was magnified by a mismatch between their self-assessed ability to take care of themselves. Thus, we have identified a possible mechanism by which future studies might intervene. Enhanced pre-operative counseling for patients with UPSI might better match expectations of patients and their families, and therefore improve their ability to realistically prepare for post-operative care.

The VESPA assessment should be considered as the first step of identifying geriatric surgical patients with the potential for complex discharge process. The original VESPA study was conducted in pre-operative surgical clinic⁸ as a paper-and-pencil assessment. Although it took less than 10 minutes to conduct,⁸ the assessment needs to be streamlined to < 5 minutes as surgical volumes continue to increase. The VESPA will also need to evolve with electronic medical records and national movements to improve care in older adults.^{21,22} In response, we have adopted national ACS recommendations to reduce the 14 ADL items to 5 ADL items (transferring, dressing or bathing, preparing meals, grocery shopping) and validated the shorter version to predict post-surgical complications.⁸ The streamlined version that includes the reduced ADL items and the additional items (cognition and falls) needed to evaluate UPSI is provided in Appendix B.

Our results should be interpreted in light of several limitations. Because we stringently defined both our outcome, complex discharge, and two of our risk groups (UPSI and the Realistic groups), these groups represented small proportions of the total population, thus limiting statistical power. Complex discharge, which we evaluated retrospectively through medical record review, was therefore limited to documented information. Clinicians and case managers with better documentation practices were therefore more likely to document

changes in discharge decisions, one of our criteria for complex discharge. Social (i.e., non-surgical) reasons for delayed discharge are likely to be poorly documented in the medical record, likely contributing to our small number of patients we defined as delayed discharge. As an approach to future research, *prospective* collection of social delays to discharge by case managers should increase sensitivity for the outcome. By collecting specific reasons for delayed discharge, future interventions to streamline the discharge process could be designed. Second, our retrospective method of classifying complex discharges missed important patient and family perspectives of the discharge planning process. Additional structured interviews would have captured more cases of complicated discharge, for example, families and patients with severe anxiety about discharge decisions, time spent on arranging family caregiving and complexity arising from patients living remotely from the hospital and/or family caregivers. Last, we used RVU groups as a crude way of controlling for the invasiveness and physiologic stress placed upon the patient during the surgery. However, there are other factors that also contribute to increased RVUs such as technical complexity e.g., laparoscopic gastrointestinal surgery, where the technology may decrease the physiologic invasiveness. For this reason, we test RVUs in broad (high versus low) categories, which reasonably maintained only complex laparoscopic surgeries (e.g., colectomy) in the high-RVU category (Table 2).

Future research on reducing complex discharge is possible if patients with UPSI can be identified pre-operatively. Presence of UPSI during the pre-operative visit should trigger early discharge planning that starts immediately, rather than waiting for the end of the hospital stay. For example, patients with UPSI can receive enhanced and individualized counseling for potential post-surgical needs such mobility limitations in their home, changes to the home that would facilitate self-care such as toileting, bathing, and getting meals. Surgery-specific needs can be discussed such as drain and wound care. To prepare for the possibility of needing additional help post discharge, counseling can include enhanced materials to introduce patients and caregivers to formal ADL and nursing care options, including post-acute rehabilitation and nursing care in skilled nursing facilities. For patients whose destination will likely be home, education can focus on home care services that are provided by health insurance and Medicare, and what types of care are not covered, thus should be pre-organized such as scheduling family helpers or purchasing private ADL care. Once admitted to the hospital for surgery, potential interventions include early discharge planning, elder-specific perioperative care such as early delirium prevention.

Conclusions

A small number of older patients with unrealistic expectations about their post-operative self-care out of proportion to detected physical, cognitive, and home environment limitations can be identified during the outpatient, pre-operative visit. Future interventions are needed to understand whether better management of their expectations can facilitate and simplify the safe discharge of patients after surgery.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1: Conceptual Model of How Unrealistic Post-Surgical Expectation of Independence (UPSI) Affects Discharge Planning Complexity

Unrealistic Post-Surgical Expectation of Independence (UPSI) is defined as having full multi-dimensional geriatric risk, yet answered “yes” to post-operative self-care ability question. The full dimensional geriatric risk includes: (1) had at least one of the geriatric risks factors: functional difficulty, cognitive impairment, and/or positive screen on the gait and mobility testing; (2) lived alone; (3) had at least one environmental risk listed in the VESPA assessment. This conceptual model proposes that patients with UPSI are more likely

to have complex discharge planning needs because of the discrepancy between their complexity and their expectations.

Table 1:

Sample Characteristics (n=382)

Variable			Mean (SD, Range) or No. (%)
Age			77.7 (5.5, 70–94)
Gender (Male)			198 (51.8)
VESPA Items	BADL [¶] /IADL [¥] Difficulty	Any Difficulty for the 6 BADLs	20 (5.2)
		Any Difficulty for the 8 IADLs	102 (26.7)
		Any Difficulty for the 14 BADLs or IADLs	104 (27.2)
	Failed Mini-Cog Test [*]		19 (5.7)
	Gait and Mobility Screen	Fall [*]	88 (24.0)
		Time-Up-and-Go Test >20 sec [*]	51 (14.4)
		Observed Abnormal/Unsteady Gait [*]	70 (20.1)
		Any of the Above Positive Gait and Mobility Screens [*]	140 (40.1)
	Any Geriatric Risk (BADL/IADL Difficulty, Failed Mini-Cog Test, or Positive Gait and Mobility Screens		189 (49.5)
	Environmental Risk	Stairs to Enter Home [*]	267 (70.1)
		No Bathroom or Bedroom on the First Floor at Home	51 (13.4)
		Home not Handicapped Equipped [*]	215 (56.6)
		Any Environmental Risk	327 (85.6)
	Live Alone [*]		102 (26.8)
	Self-Assessed Ability to Manage Themselves Alone after Discharge [*]		197 (53.8)
Risk groups	Normal [□]	178 (48.6)	
	Precautious [‡]	149 (40.7)	
	Realistic [§]	20 (5.5)	
	UPSI [£]	19 (5.2)	
WRVU [†]			19.8 (11.8, 0–52.84)
Charlson Comorbidity Index Score			3.5 (2.3, 0–14)
Length of Stay			6.2 (5.7, 2–50)

[¶]BADL: Basic Activities of Daily Living.

[¥]IADL: Instrumental Activities of Daily Living.

^{*} These rows have missing observations, so the denominator has been adjusted accordingly for: fail Mini-Cog test (46 missing); fall (16 missing); Time-Up-and-Go Test (28 missing); observed abnormal/unsteady gait (34 missing); any gait and mobility screen positive (33 missing); stairs to enter home (1 missing); home not handicapped equipped (2 missing); live alone (1 missing); self-assessed ability to manage themselves alone after discharge (16 missing); risk and expectation group (16 missing)

□ Normal: Not fully at multidimensional geriatric risk (physical or cognitive impairment + lives alone + absence of handicap adaptation at home) and “yes” to post-operative self-care ability question

‡ Cautious: Not fully at multidimensional geriatric risk and “no” to post-operative self-care ability

§ Realistic: Fully at multidimensional geriatric risk and “no” to post-operative self-care ability

£ UPSI (Unrealistic Post-Surgical expectation of Independence): Fully at multidimensional geriatric risk and “yes” to post-operative self-care ability

† WRVU: Work-related Relative Value Units of the primary procedure.

Table 2:

Procedures included in High versus Low-Risk Surgery, by Surgery Category and Work-related Relative Value Units (WRVUs)

Surgery Category	WRVU Group (Low/High)	Procedure	WRVU	Prevalence (%) within the Category
Breast (n=7)	Low	Partial mastectomy	10.13	42.86
	High	Mastectomy simple complete	15.85	42.86
		Mastectomy radical	17.46	14.29
Head and Neck (n=81)	Low	Excision of mouth lesion	1.36	2.47
		Excision face/eyelid/ears/nose/lips malignant lesion including margins .5 cm or less	1.67	1.23
		Remove tonsils and adenoids	4.22	1.23
		Laryngoscopy with tumor excision and operating microscope	4.52	1.23
		Removal of ethmoid sinus	5.14	1.23
		Implant neuroelectrodes	7.15	1.23
		Incision of windpipe	7.17	1.23
		Resect face tumor < 2 cm	9.89	1.23
		Excision of bone lower jaw	10.03	1.23
		Partial thyroid excision	11.23	4.94
		Remove palate/lesion	11.86	1.23
		Revise middle ear bone	12.03	1.23
		Reconstruct cleft palate	12.53	1.23
		Mastoidectomy	12.56	1.23
		Resect neck tumor < 5 cm	14.75	13.58
		Removal of thyroid	15.04	3.7
		Explore parathyroid glands	15.6	27.16
	High	Removal of thyroid	17.62	1.23
		Implant cochlear device	17.73	7.41
		Explore adrenal gland	18.02	2.47
		Extensive jaw surgery	18.37	1.23
		Removal of thyroid	22.01	1.23
		Removal of thyroid	23.2	12.35
		Removal of lymph nodes neck	23.95	3.7
		Extensive thyroid surgery	28.42	1.23
		Craniofacial approach skull	39.13	1.23
		Infratemporal approach/skull	47.04	1.23
GI (n=117)	Low	Excision of rectal tumor	1.91	0.85
		Upper gastrointestinal endoscopy with removal of tumor	3.2	0.85

Surgery Category	WRVU Group (Low/High)	Procedure	WRVU	Prevalence (%) within the Category
Author Manuscript Author Manuscript Author Manuscript Author Manuscript		Removal of anorectal lesion	5.12	0.85
		Diagnostic laparoscopy peritoneal/abdomen/omentum	5.14	0.85
		Laparoscope procedure liver	5.44	0.85
		Laparoscopy with biopsy	5.44	0.85
		Repair rectum-vagina fistula	8.71	0.85
		Laparoscope procedure spleen	9.34	0.85
		Laparoscopic cholecystectomy	10.47	12.82
		Appendectomy	10.6	0.85
		Excision rectal tumor transanal approach full thickness	12.13	0.85
		Exploration of abdomen	12.54	0.85
		Excise intestine lesion(s)	14.04	0.85
		Laparoscopic enterolysis	15.27	0.85
	High	Excision of stomach lesion	16.34	0.85
		Reopening of abdomen	17.63	0.85
		Freeing of bowel adhesion	18.46	2.56
		Removal of spleen total	19.55	1.71
		Laparoscopic ablation liver cryosurgery	20.8	0.85
		Removal of small intestine	20.82	0.85
		Transabdominal esophageal hiatal hernia repair	21.46	0.85
		Partial removal of colon	22.59	8.55
		Laparoscopic colectomy partial with ileum	22.95	1.71
		Fuse esophagus & stomach	23.31	0.85
		Repair bowel-skin fistula	24.2	0.85
		Removal of stomach partial	24.51	0.85
		Suture small intestine	24.72	0.85
		Repair rectum/remove sigmoid	24.8	15.38
		Partial removal of pancreas	26.32	0.85
		Laparoscopic partial colectomy	26.42	2.56
		Partial removal of colon	27.79	1.71
		Partial removal of colon	28.58	0.85
		Laparoscopy gastric bypass/roux-en-y	29.4	1.71
		Removal of pancreas	29.45	5.13
		Removal of rectum	30.76	0.85
		Removal of colon/ileostomy	34.42	0.85
		Removal of stomach partial	35.14	2.56
		Laparoscopy remove rectum with pouch	36.5	3.42

Surgery Category	WRVU Group (Low/High)	Procedure	WRVU	Prevalence (%) within the Category
		Partial removal of liver	39.01	7.69
		Fuse liver ducts & bowel	52.19	0.85
		Pancreatectomy	52.79	0.85
		Partial removal of pancreas	52.84	8.55
Other general, oncologic, and orthopedic (n=30)	Low	Removal of wrist prosthesis	6.77	3.33
		Repair initial inguinal hernia, reducible	7.96	13.33
		Repair inguinal hernia reducible	9.99	3.33
		Repair inguinal hernia blocked	11.48	3.33
		Repair ventral hernia initial reducible	11.92	3.33
		Repair ventral hernia reducible	12.37	36.67
		Repair of abdominal wall	12.41	6.67
		Laparoscopic incisional hernia repair	13.76	6.67
		Laparoscopic ventral/abdominal hernia repair includes mesh; incarcerated/strangulated	14.94	3.33
		Repair ventral hernia initial block; incarcerated or strangulated	15.38	3.33
	High	Remove spine lamina 1–2 lumbar	16.43	3.33
		Radical resect abdominal soft tissue tumor < 5 cm	16.69	6.67
		Lumbar spine fusion	22.09	3.33
		Pelvic exenteration	49.1	3.33
Plastic (n=48)	Low	Excision benign lesion face/ears/eyelids/nose/ lips/mucous membrane with margins of < .5 cm	1.05	2.08
		Skin sub graft trunk/arm/leg	1.5	4.17
		Excision malignant lesion trunk/arms/leg including margins of .5 cm or less	1.63	20.83
		malignant excision leg resection .6–1 cm	2.07	2.08
		Biopsy shoulder tissues	2.3	2.08
		Excision malignant lesion trunk/arms/leg including margins of < 3.1–4 cm	3.17	2.08
		Excision trunk/arms/legs benign including margins >4.0 cm	3.52	2.08
		Debridement bone 20 square cm or less	4.1	2.08
		Excision trunk/arms/legs malignant lesion including margins > 4 cm	5.02	2.08
		Mohs 1 stage head/neck/hands/feet/groin	6.2	2.08
		Amputation toe & metatarsal	6.64	4.17
		Biopsy/removal lymph nodes	6.74	2.08
		Removal neck/armpit lesion	7.11	2.08
		Excision abdominal wall or subfascial tumor < 5 cm	8.32	2.08

Surgery Category	WRVU Group (Low/High)	Procedure	WRVU	Prevalence (%) within the Category
		Contour of face bone lesion	8.39	2.08
		Adjacent tissue transfer scalp/arm/legs 10.1–30 square cm	9.72	2.08
		Form skin pedicle flap forehead/chin/cheek/mouth nose/axilla/groin/hand/foot	10.7	2.08
		Island pedicle flap graft	11.8	2.08
		Resect forearm/wrist tumor < 3cm	12.93	2.08
		Remove groin lymph nodes	13.62	14.58
		Remove armpit lymph nodes	13.87	4.17
		Remove pelvis lymph nodes	14.06	2.08
		Resect thigh/knee tumor < 5 cm	15.72	4.17
		Resect leg/ankle tumor < 5 cm	15.72	10.42
	High	Removal of chest wall lesion	17.78	2.08
Thoracic (n=14)	Low	Diagnostic laryngoscopy	1.1	7.14
		Bronchoscopy with biopsy(s)	3.36	7.14
		Open biopsy of lung pleura	12.91	7.14
		Repair of diaphragm hernia	14.57	21.43
		Wedge resect of lung initial	15.75	7.14
	High	Transthoracic diaphragmatic hernia repair	22.12	7.14
		Revise & repair chest wall	29.3	7.14
		Resect apical lung tumor	31.74	21.43
		Removal of esophagus	44.18	14.29
Urology (n=85)	Low	Change of bladder tube	0.9	1.18
		Cystoscopy w/biopsy(s)	2.59	1.18
		Cystoscopy and treatment	4.99	1.18
		Cystoscopy and treatment	5.44	1.18
		Cystoscopy and treatment	7.5	2.35
		Repair bladder neck	10.15	1.18
		Laser surgery of prostate	11.3	1.18
		Revision of scrotum	11.78	1.18
		Laser surgery of prostate	12.15	1.18
		Insert inflatable urethral/bladder neck sphincter	13	2.35
		Urethrolisis transvaginal with urethroscopy	13	1.18
		Male sling procedure	13.36	5.88
		Cryoablate prostate	13.6	4.71
		Removal of kidney	14.04	1.18
		Insert tandem cuff	14.19	1.18

Surgery Category	WRVU Group (Low/High)	Procedure	WRVU	Prevalence (%) within the Category
		Remove/replace urethral sphincter	14.28	1.18
		Remove/replace penis prosthesis	15.18	1.18
	High	Remove kidney open	18.68	7.06
		Fusion of ureters	20.07	1.18
		Reconstruction of urethra	20.7	1.18
		Laparoscopic ablation renal mass	21.36	1.18
		Partial removal of kidney	24.21	8.24
		Extensive prostate surgery	24.29	9.41
		Extensive prostate surgery	24.63	1.18
		Laparoscopic partial nephrectomy	27.41	1.18
		Removal of bladder & nodes	34.18	30.59
		Remove bladder/revise tract	36.33	4.71
		Remove bladder/create pouch	44.26	3.53

Table 2 includes all of the procedures of different surgery category performed in this study, divided into high versus low RVU group. The cutoff between high versus low WRVU group was 15.85 RVUs. We provide this list to assist clinicians deciding whether or not their patient would be in the high versus low-risk group. For instance, if a patient is planning a surgery with WRVU higher than a simple mastectomy, then they would have higher risk for a complex discharge.

Comparing characteristics of the exposure groups using Normal group as the comparison group (n=366)

Table 3:

Variable	Normal* (N=178)	Precautions [#] (N=149)	Realistic [§] (N=20)	UPSI [£] (N=19)
		P value [†]	P value [†]	P value [†]
Age, Mean (±SD)	77.0 (±5.2)	78.1 (±5.5)	79.2 (±4.8)	80.8 (±7.7)
Male (%)	59.6	49.7	25.0	42.1
WRVU [‡] (High) (%)	48.9	53.0	40.0	47.4
Charlson Comorbidity Index Score (2) (%)	83.7	83.2	90.0	79.0
Length of Stay, Mean (±SD)	6.0 (±5.4)	6.3 (±6.3)	4.8 (±3.1)	6.5 (±4.3)
Complex Discharge Planning (%)	5.6	5.4	5.0 [‡]	21.1 [‡]
Skill Needs at Discharge (%)	52.3	56.4	75.0	79.0
Discharged Home with Home Health Care	45.5	42.3	50.0	47.4
Discharged to Nursing Home (%)	4.5	12.1	20.0	26.3
Geriatric Complication (%)	30.3	38.3	20.0	47.4
General Surgical Complication (%)	20.2	21.5	25.0	26.3
Unplanned Readmission (%)	7.3	6.7	15.0	5.3
Death (%)	0.0	3.4	0.0	5.3

□ Normal: Not fully at multidimensional geriatric risk (physical or cognitive impairment + lives alone + absence of handicap adaptation at home) and “yes” to post-operative self-care ability question

[#] Cautious: Not fully at multidimensional geriatric risk and “no” to post-operative self-care ability

[§] Realistic: Fully at multidimensional geriatric risk and “no” to post-operative self-care ability

[£] UPSI (Unrealistic Post-Surgical expectation of Independence): Fully at multidimensional geriatric risk and “yes” to post-operative self-care ability

[†] P value (compared to the Normal group) of T-test for continuous variable and χ^2 test or Fisher's exact test (for cells with small size) for dichotomous variable.

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The Fisher's exact test for complex discharge planning in the Realistic vs UPSI group was .18

Table 4:

Logistic Regression for Complex Discharge Planning (n=366)

Variables	Odds Ratio (95% CI)	P Value
Normal* group (Comparison Group)		
Precautious [‡] group	0.9 (0.3–2.4)	0.84
Realistic [§] group	0.9 (0.1–7.9)	0.95
UPSI [£] group	4.3 (1.1–16.1)	0.03
Age	1.0 (1.0–1.1)	0.54
WRVU [¶] (high vs. low)	2.6 (1.0–6.6)	0.05
CCI [†] Score (≥ 2 vs. <2)	0.8 (0.2–2.5)	0.67

□ Normal: Not fully at multidimensional geriatric risk (physical or cognitive impairment + lives alone + absence of handicap adaptation at home) and “yes” to post-operative self-care ability question

‡ Cautious: Not fully at multidimensional geriatric risk and “no” to post-operative self-care ability

§ Realistic: Fully at multidimensional geriatric risk and “no” to post-operative self-care ability

£ UPSI (Unrealistic Post-Surgical expectation of Independence): Fully at multidimensional geriatric risk and “yes” to post-operative self-care ability

¶ WRVU: Work-related Relative Value Units of the primary procedure.

† CCI: Charlson Comorbidity Index.