Predictors of prolonged admission after outpatient female pelvic reconstructive surgery

Andrea M. Simi BAS1 | Graham C. Chapman MD2 | Jacqueline Zillioux MD3 | Sarah Martin MD3 | Emily A. Slopnick MD3

1Case Western Reserve University School of Medicine, Cleveland, Ohio, USA
2Division of Urogynecology and Pelvic Floor Disorders, Department of Obstetrics and Gynecology, Cleveland Clinic Foundation, Cleveland, Ohio, USA
3Department of Urology, Glickman Urological and Kidney Institute, Center for Female Pelvic Medicine and Reconstructive Surgery, Cleveland Clinic Foundation, Cleveland, Ohio, USA

Correspondence
Andrea M. Simi, BAS, Case Western Reserve University School of Medicine, Cleveland, OH, USA.
Email: axs1702@case.edu

Abstract
Objectives: This study aimed to determine factors associated with prolonged hospital admission following outpatient female pelvic reconstructive surgery (FPRS) and associated adverse clinical outcomes.

Methods: Using the National Surgical Quality Improvement Program database, we identified outpatient FPRS performed 2011–2016. Isolated hysterectomy without concurrent prolapse repair was excluded. Surgeries were classified as major or minor for analysis. The primary outcome was length of stay (LOS), defined as admission of ≥2 days. Secondary outcomes included complications, readmission and reoperation associated with prolonged LOS. We abstracted data on covariates, and following univariable analysis, performed backward stepwise regression analysis.

Results: A total of 29645 women were included: 12311 (41.5%) major and 17334 (58.5%) minor procedures. A total of 6.9% (2033) had a prolonged LOS. On full cohort multivariable regression analysis, patient characteristics associated with prolonged LOS were older age (odds ratio [OR]: 1.1 per 10 years, confidence interval [CI]: 1.06–1.1, p < 0.001), frailty (OR: 1.8, 95% CI: 1.3–2.6, p = 0.001), and Caucasian race (OR: 1.2, CI: 1.02–1.3, p = 0.024). Associated surgical factors included having a major surgical procedure (OR: 1.3, CI: 1.2–1.4, p < 0.001), use of general anesthesia (OR: 2.0, CI: 1.5–2.6, p < 0.001) and longer operative time (OR: 2.0, CI: 1.8–2.2, p < 0.001). The occurrence of any complication (10.3% vs. 4.7%, p < 0.001), hospital readmission (4.3% vs. 1.7%, p < 0.001), and reoperation (2.7% vs. 1.0%, p < 0.001) were more likely with prolonged LOS.

Conclusions: After outpatient FPRS, 6.9% of patients experience an admission of ≥2 days. Prolonged LOS is more common in patients who are older, frail and Caucasian, and in those who have major surgery with long operative time and general anesthesia.
INTRODUCTION

In recent years, there has been a strong shift toward outpatient surgery for low-risk female pelvic reconstructive surgery (FPRS).\(^1,2\) In a database of claims from three large US health insurers, outpatient pelvic organ prolapse (POP) procedures increased 18.5% \((p = 0.132)\), while inpatient procedures decreased 52.2% \((p = 0.002)\) from 2010 to 2013.\(^2\) Outpatient FPRS is an attractive option that can improve efficiency and decrease healthcare costs, while providing comparable safety and clinical outcomes.\(^3\) Multiple studies of FPRS have validated the safety and efficacy of outpatient protocols, with greater than 77% success in ambulatory discharge.\(^4–8\) From 2010 to 2020, 79.1% of one surgeon’s 1793 FPRS cases were discharged on the day of surgery, with no association found between same day discharge and 30-day readmission or ED visits.\(^8\) This finding further supports a growing body of literature demonstrating the advantages and minimal complications of same-day discharge.\(^4–6,8–10\)

However, the clinical benefits and financial savings associated with outpatient surgery are diminished when patients experience readmission and/or an extended hospital stay following outpatient surgery.\(^5\) Both readmission rate and prolonged length of stay (LOS) have been used as indicators of quality of care in outpatient surgery. The Centers for Medicare and Medicaid Services (CMS) reduces payments to hospitals with excess readmissions.\(^11\) Furthermore, CMS utilizes 30-day hospital readmissions and a compound metric of postoperative inpatient admissions and return visits to the hospital within a week of postsurgical discharge as measures of quality care.\(^11,12\) Thus, understanding the prevalence of and factors associated with readmission and prolonged postoperative LOS is crucial. While prior studies have reported on feasibility of same day discharge or readmission after outpatient FPRS, prolonged stay following outpatient surgery remains largely unexplored.\(^1,4,7,13–16\)

Our objective was to determine the patient and surgical factors associated with a prolonged hospital admission following outpatient FPRS, as well as the association of prolonged stay with clinical outcomes. We hypothesized that age, frailty, and undergoing a major surgical procedure would be associated with a prolonged LOS. An improved understanding of these factors will help us better select patients suited for the outpatient setting, inform postoperative expectations and patient counseling, implement targeted strategies to reduce complications, prolonged LOS and readmission, and maximize the clinical and financial benefits of outpatient FPRS.

MATERIALS AND METHODS

We performed this retrospective cohort study using 2011–2016 data from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. Surgeries labeled as outpatient and elective were included. “Outpatient” surgery in NSQIP is defined by each individual contributing hospital and may indicate same day or extended outpatient admission. Current procedural terminology codes were used to identify FPRS procedures, including POP repair with or without concurrent hysterectomy, midurethral sling placement, sling revision, and vaginal mesh revision (Table 1). We excluded cases of isolated hysterectomy performed without a concurrent prolapse repair procedure. Based on author experience and estimated average operative time, surgeries were categorized as major (sacrospinous ligament or iliococcygeus suspension, uterosacral ligament suspension, sacrocolpopexy, hysteropexy, or any case with concomitant hysterectomy) or minor (isolated midurethral sling placement, colpocleisis, anterior and/or posterior colporrhaphy, enterocoele repair, perineorrhaphy, revision or removal of vaginal mesh, or sling revision, without a concurrent major procedure). Revision of vaginal mesh can be major or minor depending on the clinical situation. In this dataset, the median operative time of a mesh revision surgery was 64 min, so it was considered minor.

The primary outcome was prolonged LOS, defined as admission of 2 or more days, after outpatient FPRS. For analysis, patients were stratified into LOS of <2 and ≥2 days. In the United States, most women are offered outpatient FPRS with same day discharge or overnight observation following major surgery. We chose 2 days as a prolonged admission because a two night stay would not be anticipated.\(^7\) Furthermore, when Medicare calculates LOS for benefit coverage and quality of care metrics, LOS is calculated using nights of hospital stay, rather than hours of stay.\(^17\) Primary analysis was performed to assess for factors associated with prolonged LOS.
Secondary analysis examined operative time, complications, readmission and reoperation associated with prolonged LOS, as reported to NSQIP within 30 days of surgery. For multivariable analysis, a long operative time was defined as greater than 75th percentile of all surgeries in the cohort. For sensitivity analysis of major and minor procedures, a prolonged operative time was calculated as >75th percentile within that subgroup.

We abstracted data on covariates including all available patient demographics, medical comorbidities, and surgical characteristics reported to NSQIP for analysis. The NSQIP Modified Frailty Index-5 was used as a measure of patient medical comorbidity burden and functional status. This score has been validated in multiple surgical fields and previously utilized in the pelvic floor surgery patient population. The Modified Frailty Index-5 considers five preoperative diagnoses that are reported to NSQIP, including hypertension requiring medication, diabetes mellitus, congestive heart failure, chronic obstructive pulmonary disease, and dependent functional health status, to calculate a frailty score. The frailty score is a sum of the number of these conditions with which a patient is diagnosed divided by 5. A score of ≥0.4 indicates frailty. Complications were analyzed as a composite rate, defined as the incidence of any complication, as well as by each individual complication reported to NSQIP. Urinary tract infection (UTI) and superficial surgical site infection were considered minor complications, while the remaining complications were considered major. The postoperative complications with an incidence of ≥0.1% in our cohort are identified in Table 4. As a sensitivity analysis, we stratified patients into those who underwent surgical procedures considered major and those who underwent only minor procedures.

2.1 Statistical analysis

Descriptive statistics were performed to assess cohort patient characteristics, perioperative details and 30-day outcomes. Variables were assessed for normality of distribution. Patients with and without prolonged LOS were compared using student’s t test, Wilcoxon rank-sum test, or Chi-square tests, as appropriate. Factors significant on univariate analysis with p < 0.05 were included in the multivariate logistic regression. Backward stepwise multivariable logistic regression analyses were performed to identify predictors of prolonged LOS as well as 30-day complications. All results yielding p < 0.05 were deemed statistically significant. Statistical analysis was performed using Stata version 15.1 (StataCorp).

3 RESULTS

3.1 Overall cohort

A total of 29645 women underwent outpatient FPRS between 2011 and 2016, including 12311 (41.5%) major and 17334 (58.5%) minor surgeries (Table 1). Mean patient age was 57.4 ± 13.1 years. Most patients were either discharged same-day (n = 9778 [33%]) or observed overnight (n = 17824 [60.2%]), while 2033 (6.9%) were admitted for at least 2 days postoperatively and thus classified as prolonged LOS. Patients who had a prolonged LOS were older (mean: 59.4 vs. 57.2 years, p < 0.001) and more likely to be frail (11.4% vs. 8.8%, p < 0.001) (Table 2). Prolonged LOS was also associated with having a major surgical procedure (8.8% vs. 5.5%, p < 0.001), general anesthesia (7.1% vs. 3.0% with nongeneral anesthesia, p < 0.001), and a longer operative time (median: 136 vs. 96 min, p < 0.001) on univariate
### TABLE 2  Patient factors associated with prolonged LOS after outpatient FPRS

|                      | Overall cohort | LOS <2 days | Prolonged LOS ≥2 days |
|----------------------|---------------|------------|-----------------------|
|                      | n (%)         | n (%)      | n (%)                 |
| Age (years), mean ± SD | 57.4 ± 13.1   | 57.2       | 59.4                  |
| Race—White           | 24205 (81.7)  | 22479 (81.4) | 1726 (84.9) |
| Diabetes             | 3028 (10.2)   | 2779 (10.1) | 249 (12.3)  |
| Current smoker       | 3422 (11.5)   | 3231 (11.7) | 191 (9.4)   |
| Obesity              | 10968 (37.1)  | 10229 (37.1) | 739 (36.4)  |
| Dependent functional status | 109 (0.4)    | 96 (0.4)   | 13 (0.6)     |
| Congestive heart failure | 16 (0.05)   | 15 (0.05)  | 1 (0.05)    |
| History of CAD       | 119 (0.4)     | 112 (0.4)  | 7 (0.3)      |
| COPD                 | 577 (2.0)     | 525 (1.9)  | 52 (2.6)     |
| Dyspnea              | 1079 (3.6)    | 993 (3.6)  | 86 (4.2)     |
| Hypertension         | 11 038 (37.2) | 10 188 (36.9) | 850 (41.8)  |
| Dialysis             | 13 (0.04)     | 13 (0.05)  | 0 (0)        |
| Ascites              | 9 (0.03)      | 7 (0.03)   | 2 (0.1)      |
| Disseminated cancer  | 33 (0.1)      | 30 (0.1)   | 3 (0.2)      |
| Chronic steroid use  | 546 (1.8)     | 503 (1.8)  | 43 (2.1)     |
| Bleeding disorder    | 227 (0.8)     | 206 (0.8)  | 21 (1.0)     |
| History of stroke    | 113 (0.4)     | 108 (0.4)  | 5 (0.3)      |
| Chronic alcohol use  | 30 (0.1)      | 29 (0.1)   | 1 (0.1)      |
| >10% weight loss in 6 months | 25 (0.1) | 22 (0.1)   | 3 (0.2)      |
| Open wound or wound infection | 63 (0.2) | 60 (0.2)   | 3 (0.2)  |
| Preoperative transfusion of >4 units | 7 (0.02) | 7 (0.03) | 0 (0) |
| Frail (Frailty-5 score ≥0.4) | 2663 (9.0) | 2432 (8.8) | 231 (11.4) |

**Abbreviations:** FPRS, female pelvic reconstructive surgery; LOS, length of stay.

### TABLE 3  Backward stepwise multivariable logistic regression analysis of patient and surgical factors associated with prolonged LOS

| Variables                          | Overall (OR [95% CI]) | p     | Major surgery (OR [95% CI]) | p     | Minor surgery (OR [95% CI]) | p     |
|------------------------------------|------------------------|-------|-----------------------------|-------|-----------------------------|-------|
| Older Age (per 10 years)           | 1.1 (1.06–1.1)         | <0.001| 1.1 (1.05–1.2)              | <0.001| 1.1 (1.03–1.2)              | 0.003 |
| Frailty                            | 1.8 (1.3–2.6)          | 0.001 | 2.3 (1.4–3.8)               | 0.001 | 1.4 (0.8–2.4)               | 0.189 |
| Race—White                         | 1.2 (1.02–1.3)         | 0.024 |                             |       |                             |       |
| Current smoker                     | 0.9 (0.8–1.1)          | 0.191 |                             |       |                             |       |
| General anesthesia                 | 2.0 (1.5–2.6)          | <0.001| 2.0 (1.2–3.5)               | 0.01  | 1.7 (1.2–2.3)               | 0.003 |
| Long operative time                | 2.0 (1.8–2.2)          | <0.001| 1.6 (1.4–1.8)               | <0.001| 3.2 (2.8–3.6)               | <0.001|
| Major surgery                      | 1.3 (1.2–1.4)          | <0.001|                             |       |                             |       |

**Abbreviation:** LOS, length of stay.
analysis. On multivariable logistic regression analysis, patients were more likely to have a prolonged LOS if they were older (odds ratio [OR]: 1.1 per 10 years, confidence interval [CI]: 1.06–1.1, \( p < 0.001 \)), frail (OR: 1.8, 95% CI: 1.02–1.3, \( p = 0.024 \)), or underwent a major surgical procedure (OR: 1.3, CI 1.2–1.4, \( p < 0.001 \)) under general anesthesia (OR: 2.0, CI: 1.5–2.6, \( p < 0.001 \)) with a long operative time (OR: 2.0, CI: 1.8–2.2, \( p < 0.001 \)) (Table 3).

Table 4 details 30-day postoperative adverse events, readmissions, and reoperation rates. Overall, 1495 (5.0%) of patients developed a complication, most commonly a UTI (\( n = 1040 \) [3.5%]). Patients with prolonged LOS were more likely to experience any complication (10.3% vs. 4.7%, \( p < 0.001 \)). Specifically, patients with prolonged LOS were more likely to be diagnosed with a UTI (5.8% vs. 3.3%, \( p < 0.001 \)), an organ space infection (0.9% vs. 0.3%, \( p < 0.001 \)), pneumonia (0.2% vs. 0.1%, \( p = 0.02 \)), and septic shock (0.15% vs. 0.01%, \( p < 0.001 \)). An intraoperative blood transfusion was also more common in the prolonged LOS cohort (3.1% vs. 0.2%, \( p < 0.001 \)). On multivariable logistic regression analysis, the incidence of any postoperative complication remained more likely in patients with a prolonged LOS (OR: 1.5; CI: 1.4–1.6, \( p < 0.001 \)). Patients with a bleeding disorder (OR: 2.1, CI: 1.4–3.2, \( p = 0.001 \)) were also more likely to experience a complication, adjusting for frailty, obesity, preoperative dyspnea and having a major surgery (Table 5).

Hospital readmission was required in 553 (1.9%) patients, and patients who had a prolonged LOS were more likely to be readmitted (4.3% vs. 1.7%, \( p < 0.001 \)). Overall, 331 (1.1%) patients underwent reoperation, which was also more likely after a prolonged admission.

### Table 4 30-day adverse events after outpatient FPRS

| Variables | Overall | LOS <2 days | Prolonged LOS ≥2 days | \( p \) |
|-----------|---------|-------------|-----------------------|------|
| Any complication | 1495 (5.0) | 1285 (4.7) | 210 (10.3) | <0.001 |
| Any major complication | 378 (1.3) | 283 (1.0) | 95 (4.7) | <0.001 |
| Deep wound infection | 25 (0.1) | 23 (0.1) | 2 (0.1) | 0.821 |
| Organ space infection | 101 (0.3) | 82 (0.3) | 19 (0.9) | <0.001 |
| Wound dehiscence | 37 (0.1) | 36 (0.1) | 1 (0.1) | 0.317 |
| Intraoperative blood transfusion | 111 (0.4) | 49 (0.2) | 62 (3.0) | <0.001 |
| Sepsis | 53 (0.2) | 50 (0.2) | 3 (0.2) | 0.730 |
| Pneumonia | 20 (0.1) | 16 (0.1) | 4 (0.2) | 0.020 |
| Deep vein thrombosis | 21 (0.1) | 17 (0.1) | 4 (0.2) | 0.027 |
| Pulmonary embolism | 27 (0.1) | 24 (0.1) | 3 (0.2) | 0.382 |
| C. diff infection | 12 (0.1) | 11 (0.1) | 1 (0.1) | 0.788 |
| Any minor complication | 1165 (3.9) | 1036 (3.8) | 129 (6.4) | <0.001 |
| Superficial wound infection | 134 (0.5) | 120 (0.4) | 14 (0.7) | 0.099 |
| Urinary tract infection | 1040 (3.5) | 923 (3.3) | 117 (5.8) | <0.001 |
| Reoperation | 331 (1.1) | 276 (1.0) | 55 (2.7) | <0.001 |
| Readmission | 553 (1.9) | 466 (1.7) | 87 (4.3) | <0.001 |

Note: Only complications with incidence ≥0.1% were included.

Abbreviations: FPRS, female pelvic reconstructive surgery; LOS, length of stay.
The most common reoperation was revision or removal of a ureteral stent occurred in 10 cases and cystoscopy removal (12 cases), as patients often underwent the most common reoperation was sling revision/p (2.7% vs. 1.1%, p < 0.001). The rate of readmission (3.8% vs. 2.1%, p < 0.001) and require a longer LOS were more likely to experience a prolonged LOS of ≥2 days. This pattern was consistent in sub-analysis by major and minor surgery. The rate of prolonged LOS found in our study is consistent with prior literature, in which 4.8%–9.7% of patients experience prolonged LOS of ≥2 nights following gynecologic and urologic procedures. While an overnight stay following outpatient FPRS is common practice in the United States for higher risk patients, this incidence of prolonged LOS highlights the opportunity for improvement of postoperative patient experience and outcomes when clinically safe and feasible. Factors examined in this study may not necessarily be causative of prolonged LOS but addressing these associations can facilitate better patient selection and surgical optimization.

Patient demographic factors found to correlate with prolonged LOS can inform more appropriate patient selection for outpatient surgery, direct patient counseling and, when modifiable, may be adjusted to maximize postoperative outcomes. Numerous past studies have shown similar associations between baseline comorbidities and LOS. While an overnight stay following outpatient FPRS is common practice in the United States for higher risk patients, this incidence of prolonged LOS highlights the opportunity for improving postoperative patient experience and outcomes when clinically safe and feasible. Factors examined in this study may not necessarily be causative of prolonged LOS but addressing these associations can facilitate better patient selection and surgical optimization.

Outpatient surgery for pelvic floor conditions is becoming more commonplace, yet some patients receive additional inpatient care. In our cohort, most patients (60.2%) who underwent surgery for POP, urinary incontinence or other pelvic floor conditions were observed overnight, with 6.9% experiencing a prolonged LOS of ≥2 days. This pattern was consistent in sub-analysis by major and minor surgery. The rate of prolonged LOS found in our study is consistent with prior literature, in which 4.8%–9.7% of patients experience prolonged LOS of ≥2 nights following gynecologic and urologic procedures. While an overnight stay following outpatient FPRS is common practice in the United States for higher risk patients, this incidence of prolonged LOS highlights the opportunity for improvement of postoperative patient experience and outcomes when clinically safe and feasible. Factors examined in this study may not necessarily be causative of prolonged LOS but addressing these associations can facilitate better patient selection and surgical optimization.

Patient demographic factors found to correlate with prolonged LOS can inform more appropriate patient selection for outpatient surgery, direct patient counseling and, when modifiable, may be adjusted to maximize postoperative outcomes. Numerous past studies have shown similar associations between baseline comorbidities and LOS. While an overnight stay following outpatient FPRS is common practice in the United States for higher risk patients, this incidence of prolonged LOS highlights the opportunity for improving postoperative patient experience and outcomes when clinically safe and feasible. Factors examined in this study may not necessarily be causative of prolonged LOS but addressing these associations can facilitate better patient selection and surgical optimization.

### DISCUSSION

A total of 12311 patients (41.5%) underwent a major procedure, with or without a concurrent minor procedure (Table 1). Mean age was 58.1 ± 12.6 years. Most patients were observed overnight following their major surgery (n = 9370 [76.1%]), while 1079 (8.8%) had prolonged LOS. Prolonged LOS was associated with older age (OR: 1.1 per 10 years, CI: 1.05–1.2, p < 0.001), frailty (OR: 2.3, CI: 1.4–3.8, p = 0.001), general anesthesia (OR: 2.0, CI: 1.2–3.5, p = 0.01), and a long operative time (OR: 1.6, CI: 1.4–1.8, p < 0.001) (Table 3). Similar to the overall cohort, patients with a prolonged LOS were more likely to develop a complication (10.6% vs. 4.9%, p < 0.001), require readmission (3.8% vs. 2.1%, p < 0.001) or undergo reoperation (2.7% vs. 1.1%, p < 0.001). In this cohort, the most common reoperation was sling revision/removal (12 cases), as patients often underwent concomitant major and minor procedures. Insertion of a ureteral stent occurred in 10 cases and cystoscopy was performed in 8 cases.

### Minor surgery cohort

A minor surgery, without concomitant major procedure, was performed in 17334 (58.5%) patients, including 10223 sling placements, 8547 anterior and/or posterior colporrhaphies, 437 colpocleises, and 809 sling or other vaginal mesh revision or excision procedures. Patients undergoing minor surgery had a mean age of 56.9 ± 13.3 years. Most patients were discharged same-day (n = 7916 [45.7%]) or after overnight observation (n = 8464 [48.8%]), while 954 patients (5.5%) had prolonged LOS. A prolonged LOS was associated with older age (OR: 1.1 per 10 years, CI: 1.03–1.2, p < 0.001), Caucasian race (OR: 1.3, CI: 1.1–1.6, p = 0.004), general anesthesia (OR: 1.7, CI: 1.2–2.3, p = 0.003), and long operative time (OR: 3.2, CI: 2.8–3.6, p < 0.001), adjusting for frailty and smoking (Table 3). Patients who required a longer LOS were more likely to experience a complication (10.1% vs. 4.5%, p < 0.001) and require readmission (4.8% vs. 1.4%, p < 0.001) or reoperation (2.7% vs. 1.0%, p < 0.001). The most common reoperation in this cohort was removal or revision of a sling (33 cases), followed by cystoscopy (15 cases) and treatment of wound dehiscence (9 cases).
The association of Caucasian race with prolonged postoperative LOS must also be investigated further. Previous studies have examined the relationship between race and surgical outcomes and have revealed an increased likelihood of postoperative complications for minority women undergoing POP repair, colpopexy and MUS.\textsuperscript{30–33} As such, it has been shown that women undergoing FPRS are vulnerable to health disparities. In contrast, race was not significantly associated with postoperative complication in our study. The data instead suggests that white patients have a longer LOS than non-white patients for reasons other than a complication. It is possible that inherent racial biases may play a role in clinical decision making, but additional investigation is needed.

Operative factors associated with prolonged LOS should also be considered. This study found that longer operative time, undergoing major surgery, and general anesthesia were independently associated with extended LOS. These findings were consistent with previous studies that report association between long operative time and prolonged LOS.\textsuperscript{13,23–25} However, prior studies have shown mixed results regarding the association of major surgical procedures. A study of prolonged LOS following hysterectomy found that the 75th percentile of LOS was 1 day for minimally invasive (laparoscopic or robotic-assisted), 2 days for vaginal and 3 days for abdominal hysterectomy, demonstrating that a more invasive surgical route results in a longer LOS.\textsuperscript{24} In contrast, a study of risk factors for prolonged LOS following laparoscopic gynecologic surgery did not find surgical complexity to be associated with prolonged LOS and noted similar risk estimates for prolonged LOS when low complexity procedures were excluded from multivariate analysis.\textsuperscript{10} While surgical complexity, operative time and anesthetic method may be inherently linked, recognizing these associations with prolonged LOS can better inform postoperative expectations and introduce surgical streamlining when possible.

Consistent with our findings, the association of general anesthesia with unanticipated admission following outpatient surgery has been previously documented in a broad cohort of patients at a tertiary care center (OR: 20.8 among a cohort of surgeries ≥60 min).\textsuperscript{34} In a study of unplanned admission following ambulatory general surgery cases, 25% of patients were admitted for anesthesia-related reasons, such as postoperative nausea or vomiting, drowsiness, abnormal vital signs or lasting anesthesia.\textsuperscript{35} The high rate of general anesthesia use reported in this study is consistent with previously quoted rates of GA for FPRS in the United States.\textsuperscript{36} While use of general anesthesia and longer, more complex surgical procedures are necessary and worthwhile in specific cases, an effort should be made to streamline surgical procedures and minimize use of general anesthesia when possible to reduce patient admissions and prolonged stay. Spinal epidural anesthesia, monitored anesthesia care and local anesthesia are promising alternatives. When studied in the context of outpatient vaginal pelvic floor surgery, spinal anesthesia was found to be safe and not associated with an increased risk of postoperative urinary retention.\textsuperscript{37,38} Additionally, a prospective study of 20 women undergoing vaginal hysterectomy and pelvic floor reconstruction reported no significant difference in 24 h postoperative pain scores between those who received local anesthesia with IV sedation and those who received combined spinal epidural regional anesthesia.\textsuperscript{39} Alternative methods of anesthesia in the context of outpatient FPRS should be considered as a potential mechanism to reduce prolonged LOS.

Prolonged LOS following outpatient FPRS is associated with increased complication risk, readmission and reoperation in our cohort. UTI and delirium are two primary considerations for older patients, who we have identified as more likely to have a longer LOS. Increased age has previously been associated with risk for catheter-associated UTI (CAUTI) and delirium in the hospital setting.\textsuperscript{40,41} Delirium, which can start elderly patients on a downward slope of loss of independence and impaired physical strength, occurs at an incidence of 6%–56% among the general hospitalized population, with prevalence increasing with patient age.\textsuperscript{41} Importantly, prolonged LOS and diagnosis and management of complications incurs greater hospital costs, diminishing the intended financial savings of outpatient surgery. While the greatest costs are incurred within 24 h of surgery, complications have been associated with higher total charges ($30,896 vs. $9,239) in a study of patients undergoing major surgery.\textsuperscript{25,42} Importantly, the association of prolonged LOS with complications, readmission and reoperation does not necessarily imply causation. While postoperative complications may result from a prolonged LOS, perioperative complications may be the primary reason for a longer admission. Additionally, patient factors associated with prolonged LOS may also be confounders responsible for increased perioperative complications, readmission or reoperation. Understanding these caveats, careful patient selection and preoperative optimization for outpatient FPRS may nonetheless help minimize complications and maximize financial benefits.

Overall, this study highlights patient and surgical factors that can inform better patient selection and postoperative expectations for FPRS. However, the retrospective study design and use of the NSQIP database present certain study limitations. NSQIP only includes data within 30 postoperative days, and our study
therefore does not assess longer term outcomes. Furthermore, NSQIP defines a surgery as “outpatient” or “inpatient” according to the definition set by each individual reporting institution and is limited in the included data. For example, NSQIP does not specify extent and location of surgical revision of vaginal mesh, making the classification of these procedure as major or minor surgery more challenging. Furthermore, the use of a retrospective database based on coding confers inherent inaccuracies and missing data due to coding errors. While we limited our study to surgeries that, in the authors’ experience, are performed outpatient, this may not be consistent across institutions. Similarly, the setting of “outpatient” surgery is undefined and could be a hospital setting or freestanding ambulatory surgery center, which may impact admission rates. Lastly, some factors and complications that were not significantly associated with a prolonged LOS in this study may still be important to consider due to their clinical severity and significance.

In conclusion, after outpatient FPRS, 6.9% of patients require a prolonged postoperative LOS of at least 2 days in this national sample. In this complete cohort, prolonged LOS is more common in patients who are older, frail and Caucasian and in those who undergo a major surgery with long operative time and general anesthesia. Associations largely hold true in sub-analysis of major and minor surgery cohorts. Acknowledgement of these associations may help identify appropriate surgical candidates for outpatient surgery, direct pre-operative medical optimization and operative safety improvements and inform postoperative expectations.

1. Procedures and anesthesia types performed during outpatient FPRS
2. Patient factors associated with prolonged LOS after outpatient FPRS
3. Backward stepwise multivariable logistic regression analysis of patient and surgical factors associated with prolonged LOS
4. 30-day adverse events after outpatient FPRS
5. Backward stepwise multivariable logistic regression analysis of patient and surgical factors associated with a complication after outpatient FPRS

There were no funding sources for this study. The authors report no disclosures. All study-related procedures were performed in accordance with good clinical practice, institutional guidelines, and applicable rules and regulations. Patient data was accessed via an open-source, HIPAA-compliant surgical outcomes database. All references were properly cited in accordance with AMA guidelines. This was a retrospective study that does not meet criteria for clinical trial registration. All authors were involved with manuscript drafts, edits, and revisions.

ORCID
Andrea M. Simi  http://orcid.org/0000-0001-9017-313X
Jacqueline Zillioux  http://orcid.org/0000-0002-9170-3056
Sarah Martin  http://orcid.org/0000-0002-7983-6411

REFERENCES
1. Slopnick EA, Hijaz AK, Nguyen CT, et al. National surgical trends and perioperative outcomes of midurethral sling placement for stress urinary incontinence. Urology. 2017;99: 57-61.  doi:10.1016/j.urology.2016.07.027
2. Sammarco AG, Swenson CW, Kamdar NS, et al. Rate of pelvic organ prolapse surgery among privately insured women in the United States, 2010-2013. Obstet Gynecol. 2018;131(3):484-492.  doi:10.1097/AOG.0000000000002485
3. Shnaider I, Chung F. Outcomes in day surgery. Curr Opin Anaesthesiol. 2006;19(6):622-629.  doi:10.1097/ACO.0b013e328010107e
4. Berger AA, Tan-Kim J, Menree SA. Comparison of 30-day readmission after same-day compared with next-day discharge in minimally invasive pelvic organ prolapse surgery. Obstet Gynecol. 2020;135(6):1327-1337.  doi:10.1097/AOG.0000000000003871
5. Arunkalaivanan AS, Sajja A, Kubal U. Evaluation of safety and feasibility of ambulatory urogynaecological procedures in a 24-h setting. Int Urogynecol J. 2010;21(10):1219-1222.  doi:10.1007/s00192-010-1174-5
6. Lamblin G, Courtieu C, Bensouda-Miguet C, et al. Outpatient vaginal surgery for pelvic organ prolapse: a prospective feasibility study. Minerva Ginecol. 2020;72(1):19-24.  doi:10.23736/S0026-4784.20.04510-4
7. Carter-Brooks CM, Du AL, Ruppert KM, Romanova AL, Zyczynski HM. Implementation of a urogynecology-specific enhanced recovery after surgery (ERAS) pathway. Am J Obstet Gynecol. 2018;219(5):495.e1-495.e10.  doi:10.1016/j.ajog.2018.06.009
8. Zillioux J, Werneburg GT, Goldman HB. Same-day discharge across FPMRS surgical cases is safe and feasible: a 10-year single-surgeon experience. Neurourol Urodyn. 2021; 2021; 40(7):1754-1760.  doi:10.1002/NAU.24739
9. Meyer CP, Hollis M, Cole AP, et al. Complications following common inpatient urological procedures: temporal trend analysis from 2000 to 2010. Eur Urol Focus. 2016;2(1):3-9.  doi:10.1016/j.euf.2015.10.001
10. Zandi B, Frumovitz M, Jofre MF, et al. Risk factors for prolonged hospitalization after gynecologic laparoscopic surgery. Gynecol Oncol. 2012;126(3):428-431.  doi:10.1016/j.ygyno.2012.05.037
11. Hospital Readmissions Reduction Program (HRRP) CMS. https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program, Accessed July 18, 2020.
12. New Haven Health Services Corporation Y, for Outcomes Research C. 2016 Measure Updates and Specifications Report Hospital Visits after Hospital Outpatient Surgery Measure (Risk-Standardized Hospital Visits within 7 Days After Hospital Outpatient Surgery Measure) Version 1.1.; 2016.
13. Kohut A, Earnhardt MC, Cuccolo NG, et al. Evaluating unplanned readmission and prolonged length of stay following minimally invasive surgery for endometrial cancer. *Gynecol Oncol*. 2020;156(1):162-168. doi:10.1016/j.gyno.2019.08.023

14. Rambachan A, Matulewicz RS, Pilecki M, Kim JYS, Kundra SD. Predictors of readmission following outpatient urological surgery. *J Urol*. 2014;192(1):183-188. doi:10.1016/j.juro.2013.12.053

15. Sheyn D, El-Nashar S, Billow M, Mahajan S, Duarte M, Pollard R. Readmission rates after same-day discharge compared with postoperative day 1 discharge after benign laparoscopic hysterectomy. *J Minim Invasive Gynecol*. 2018;25(3):484-490. doi:10.1016/j.jmig.2017.10.013

16. Nensi A, Coll-Black M, Leyland N, Sobel ML. Implementation of a same-day discharge protocol following total laparoscopic hysterectomy. *J Obstet Gynecol Canada*. 2018;40(1):29-35. doi:10.1016/j.jogc.2017.05.035

17. FY 2020 Final Rule and Correction Notice Tables | CMS. https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/FY2020-IPPS-Final-Rule-Home-Page-Items/FY2020-IPPS-Final-Rule-Tables, Accessed April 3, 2021.

18. User Guide for the 2016 ACS NSQIP Participant Use Data File (PUF). https://www.facs.org/-/media/files/quality-programs/ nsqip/nsqip_puf_userguide_2016.ashx, Published 2017. Accessed December 16, 2020.

19. Chimukangara M, Helm MC, Frelich MJ, et al. A 5-item frailty index based on NSQIP data correlates with outcomes following paraesophageal hernia repair. *Surg Endosc*. 2017;31(6):2509-2519. doi:10.1007/s00464-016-5253-7

20. Subramaniam S, Aalberg JJ, Soriano RP, Divino CM. New 5-factor modified frailty index using American College of Surgeons NSQIP Data. *J Am Coll Surg*. 2018;226(2):173-181. e8. doi:10.1016/j.jamcollsurg.2017.11.005

21. Holzgrefe RE, Wilson JM, Staley CA, Anderson TL, Wagner ER, Gottschalk MB. Modified frailty index is an effective risk-stratification tool for patients undergoing total shoulder arthroplasty. *J Shoulder Elb Surg*. 2019;28(7):1232-1240. doi:10.1016/j.jse.2018.12.004

22. Chapman GC, Sheyn D, Slopnick EA, et al. Perioperative safety of surgery for pelvic organ prolapse in elderly and frail patients. *Obstet Gynecol*. 2020;135(3):599-608. doi:10.1097/AOG.000000000003682

23. Wallner LP, Dunn RL, Sarma AV, Campbell DA, Wei JT. Risk factors for prolonged length of stay after urologic surgery: the national surgical quality improvement program. *J Am Coll Surg*. 2008;207(6):904-913. doi:10.1016/j.jamcol.2008.08.015

24. Agrawal S, Chen L, Tergas AI, et al. Characteristics associated with prolonged length of stay after hysterectomy for benign gynecologic conditions. *Am J Obstet Gynecol*. 2018;219(1):89.e1-89.e15. doi:10.1016/j.ajog.2018.05.001

25. Collins TC, Daley J, Henderson WH, Khuri SF. Risk factors for prolonged length of stay after major elective surgery. *Ann Surg*. 1999;230(2):251-259. doi:10.1097/00000658-199908080-00016

26. McAleese P, Odlng-Smee W. The effect of complications on length of stay. *Ann Surg*. 1994;220(6):740-744. doi:10.1097/00000658-199412000-00006

27. Michalik C, Maciukiewicz P, Drewa T, Kienig J, Juszczak K. Fraility, geriatric assessment and prehabilitation in elderly patients undergoing urological surgery—is there a need for change of the daily clinical practice? Synthesis of the available literature. *Cent Eur J Urol*. 2020;73(2):220-225. doi:10.5173/ceju.2020.0036r1

28. Minnella EM, Awasthi R, Bouquet-Dion G, et al. Multimodal prehabilitation to enhance functional capacity following radical cystectomy: a randomized controlled trial. *Eur Urol Focus*. 2019;7(1):132-138. doi:10.1016/j.euf.2019.05.016

29. Ploussard G, Almeras C, Beauval JB, et al. A combination of enhanced recovery after surgery and prehabilitation pathways improves perioperative outcomes and costs for robotic radical prostatectomy. *Cancer*. 2020;126(18):4148-4155. doi:10.1002/cncr.33061

30. Bretschneider CE, Sheyn D, Mahajan S, Propst K, Ridgeway B. Complications following vaginal colpopexy for the repair of pelvic organ prolapse. *Int Urogynecol J*. 2021;32(4):993-999. doi:10.1007/S00192-020-04521-Z

31. Anger JT, Rodríguez LV, Wang Q, Chen E, Pashos CL, Litwin MS. Racial disparities in the surgical management of stress incontinence among female medicare beneficiaries. *J Urol*. 2007;177(5):1846-1850. doi:10.1016/J.JURO.2007.01.035

32. Roberts K, Sheyn D, Emi Bretschneider C, Mahajan ST, Mang J. Perioperative complication rates after colpopsy in african american and hispanic women. *Female Pelvic Med Reconstr Surg*. 2020;26(10):597-602. doi:10.1016/SPV.0000000000000633

33. Cardenas-Trowers OO, Gaskins JT, Francis SL. Association of patient race with type of pelvic organ prolapse surgery performed and adverse events. *Female Pelvic Med Reconstr Surg*. 2021;27(10):595-601. doi:10.1016/SPV.00000000001000

34. Mingus ML, Bodian CA, Bradford CN, Eisenkraft JB. Prolonged surgery increases the likelihood of admission of scheduled ambulatory surgery patients. *J Clin Anesth*. 1997;9(6):446-450. doi:10.1016/S0952-8180(97)00098-6

35. Zulquifer FA, Pattanayak K Evaluation of unplanned admission following day surgery at a new surgical centre in London. Ambulatory Surgery. https://www.researchgate.net/publication/ 285966476_Evaluation_of_unplanned_admission_following_day_surgery_at_a_new_surgical_centre_in_London, Published 2009. Accessed June 23, 2020.

36. Smith PE, Hade EM, Tan Y, Pandya LK, Hundley AF, Hudson CO. Mode of anesthesia and major perioperative outcomes associated with vaginal surgery. *Int Urogynecol J*. 2020;31(1):181-189. doi:10.1007/S00192-019-03908-X

37. Alas A, Hidalgo R, Espaillat L, Devakumar H, Davila GW, Hurtado E. Does spinal anesthesia lead to postoperative urinary retention in same-day urogynecology surgery? a retrospective review. *Int Urogynecol J*. 2019;30(8):1283-1289. doi:10.1007/s00192-019-03893-1

38. Alas A, Martin L, Devakumar H, et al. Anesthetics’ role in postoperative urinary retention after pelvic organ prolapse surgery with concomitant midurethral slings: a randomized clinical trial. *Int Urogynecol J*. 2020;31(1):205-213. doi:10.1007/s00192-019-03917-w

39. Athanasiou S, Zacharakis D, Grigoriadis T, et al. Vaginal hysterectomy with anterior and posterior repair.
for pelvic organ prolapse under local anesthesia: results of a pilot study. doi:10.1007/s00192-020-04326-0

40. Park JI, Bliss DZ, Chi C-L, Delaney CW, Westra BL. Factors associated with healthcare-acquired catheter-associated urinary tract infections. J Wound, Ostomy Cont Nurs. 2018;45(2):168-173. doi:10.1097/WON.0000000000000409

41. Inouye SK. Delirium in older persons. N Engl J Med. 2006;354(11):1157-1165. doi:10.1056/NEJMra052321

42. Kalish RL, Daley J, Duncan CC, Davis RB, Coffman GA, Iezzoni LI. Costs of potential complications of care for major surgery patients. Am J Med Qual. 1995;10(1):48-54. doi:10.1177/0885713X9501000108

How to cite this article: Simi AM, Chapman GC, Zillioux J, Martin S, Slopnick EA. Predictors of prolonged admission after outpatient female pelvic reconstructive surgery. Neurourol Urodyn. 2022;41:1031-1040. doi:10.1002/nau.24924