Unplanned Hip Arthroplasty Imposes Clinical and Cost Burdens on Treating Institutions

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Abstract

Background Emergent surgery has been shown to be a risk factor for perioperative complications. Studies suggest that patient morbidity is greater with an unplanned hip arthroplasty, although it is controversial whether unplanned procedures also result in higher patient mortality. The financial impact of these procedures is not fully understood, as the costs of unplanned primary hip arthroplasties have not been studied previously.

Questions/purposes We asked: (1) What are the institutional costs associated with unplanned hip arthroplasties (primary THA, hemiarthroplasty, revision arthroplasty,

including treatment of periprosthetic fractures, dislocations, and infections)? (2) Does timing of surgery (urgent/unplanned versus elective) influence perioperative outcomes such as mortality, length of stay, or need for advanced care? (3) What diagnoses are associated with unplanned surgery and are treated urgently most often? (4) Do demographics and insurance status differ between admission types (unplanned versus elective hip arthroplasty)?

Methods We prospectively followed all 419 patients who were admitted to our Level I trauma center in 2011 for procedures including primary THA, hemiarthroplasty, and revision arthroplasty, including the treatment of periprosthetic fractures, dislocations, and infections. Fifty-seven patients who were treated urgently on an unplanned basis were compared with 362 patients who were treated electively. Demographics, admission diagnoses, complications, and costs were recorded and analyzed statistically.

Results Median total costs were 24% greater for patients admitted for unplanned hip arthroplasties (USD18,206 [USD15,261–27,491] versus USD14,644 [USD13,511–16,309]; $p < 0.0001$) for patients admitted for elective arthroplasties. Patients with unplanned admissions had a 67% longer median hospital stay (5 days [range, 4–9 days] versus 3 days [range, 3–4 days]; $p < 0.0001$) for patients with elective admissions. Mortality rates were equivalent between groups ($p = 1.0$). Femoral fracture ($p < 0.0001$), periprosthetic fracture ($p = 0.01$), prosthetic infection ($p = 0.005$), and prosthetic dislocation ($p < 0.0001$) were observed at higher rates in the patients with unplanned admissions. These patients were older ($p = 0.04$), less likely to have commercial insurance ($p < 0.0001$), more likely to be transferred from another institution ($p < 0.0001$), and more likely to undergo a revision procedure ($p < 0.0001$).

Conclusions Unplanned arthroplasty and urgent surgery are associated with increased financial and clinical burdens,

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which must be accounted for when considering bundled quality and reimbursement measures for these procedures. *Level of Evidence* Level II, therapeutic study. See Instructions for Authors for a complete description of levels of evidence.

Introduction

The number of THAs more than doubled between 1990 and 2004 [14], and projections indicate that demand for THAs and revision hip arthroplasties will increase by 174% and 137%, respectively, by 2030 [12]. However, the gap between arthroplasty charges and Medicare reimbursements has increased, resulting in a substantial financial burden on the healthcare system [18]. Although many arthroplasties are performed electively, 12% of THAs, 79% of hemiarthroplasties, and 22% of revision hip arthroplasties are performed urgently on an unplanned basis [27]. An urgent arthroplasty plays an important role in a hip fracture, because operative delay has been associated with increased mortality [3, 6, 24]. An unplanned arthroplasty also may be needed in a revision hip arthroplasty to address mechanical failure or periprosthetic fracture [23].

Emergent surgery has long been recognized by anesthesiologists as an important surgical consideration [8, 9, 21]. Emergent surgery has been shown to be a significant predictor of serious cardiac [10, 13] and other perioperative complications [26]. It also is a predictor of postoperative mortality [7, 20]. Although hip arthroplasties rarely are performed on a truly emergent basis, the risks of urgent and unplanned (ie, not electively scheduled) hip arthroplasties are unclear. Some literature suggests that patients undergoing unplanned revision hip arthroplasties had similar mortality rates [23] and infection risks [2] when compared with patients having elective arthroplasties. However, larger studies of patients undergoing urgent arthroplasties showed they had longer hospital stays with unplanned revision hip arthroplasties and increased mortality for unplanned THAs [27] and revision hip arthroplasties [22, 27].

With increasing complexity and comorbidities in patients undergoing arthroplasties [11, 14], it is critical to understand the additional risks of unplanned surgery. Because the risks remain unclear, it is necessary to further assess the clinical outcomes and burden associated with unplanned admissions and to understand what specific demographic factors and diagnoses may be associated with poorer outcomes. Additionally, the financial burden of unplanned admissions is largely unknown, with one study of unplanned revision hip arthroplasties showing increased charges with these procedures that ultimately may cost the healthcare system more than USD 100 million [22]. Understanding the costs of unplanned hip arthroplasties

also proves important regarding resource allocation and the strains on healthcare systems [23].

In comparing patients undergoing hip arthroplasties treated electively at our institution with those treated on an urgent, unplanned basis, we sought to determine: (1) the institutional costs associated with unplanned (urgent) hip arthroplasty (including THA, hemiarthroplasty, and revision arthroplasty, including management of fractures, dislocations, and infections); (2) if the timing of surgery (urgent/unplanned versus elective) influences perioperative outcomes such as mortality, length of stay, or need for advanced care; (3) the diagnoses that are associated with unplanned surgery and most often are treated urgently; and, (4) if demographics and insurance status differ between admission types (unplanned versus elective hip arthroplasty).

Patients and Methods

As part of a patient safety initiative at our institution we prospectively followed all 419 patients who were admitted to our Level I trauma center in 2011 for hip arthroplasties including primary THAs, hemiarthroplasties, and revision arthroplasties, and including the management of periprosthetic fractures, dislocations, and infections. Admission status information derived from hospital coding data was available for all 419 patients. The study was performed according to a protocol approved by our institution's ethical review board.

At our institution, an admission was classified as elective if it was planned and scheduled in advance in the outpatient setting, and in-system patients were defined as those who presented directly to our arthroplasty service or clinic. Urgent, unplanned admissions involved patients presenting for unscheduled, immediate admission through the clinic, emergency department, or as direct transfers from other hospitals. Patients were considered to be transferred if they were referred to our service after being seen previously by a physician at an outside hospital or clinic and their admittance to our hospital was coordinated by the facility transfer center.

We performed a cohort study to analyze the demographic and clinical characteristics of the subgroups. Fifty-seven patients were admitted on an urgent basis and composed the unplanned arthroplasty group. These 57 patients were compared with 362 patients who were admitted and treated on an elective basis. Subgroup comparisons of notable metrics also were completed to control for some of the obvious confounders in our data. One comparison was limited to in-system patients, whereas a second was focused on patients 65 years and older. Unplanned admissions to our institution represented 13.6% of patients undergoing hip arthroplasties during the study period.

Demographic information, including sex, age, and race, was recorded for all patients. Admission source, admission diagnosis, severity on admission, risk of mortality, relative expected mortality, expected and actual length of stay, intensive care unit days, blood transfusions, in-hospital mortality, and discharge status also were noted. The measures of severity of illness on admission and risk of mortality were based on treatment acuity of the patient as determined by the admitting physician. The relative expected mortality model of expected and observed mortality values and the expected length of stay were calculated using an algorithm that accounts for morbidity and mortality data derived from the prior year's institutional data. Financially related parameters such as insurance type and expected and observed costs were tracked. All financial metrics were derived from the inpatient care episode and did not extend past the date of discharge.

Financial metrics were derived from institutional benchmarking data generated on an annual basis from the University HealthSystem Consortium (UHC; Chicago, IL, USA). Data are generated with the Clinical Data Base/Resource Manager (CDB/RM, v1.5.0.10). UHC risk adjustment modeling uses 3 M™ APR-DRG Grouper software (3 M Health Information Systems, Salt Lake City, UT, USA). These data include “expected” modeling based on prior year's data, such as relative mortality statistics. The expected cost accounts for previous patients with similar demographic and clinical characteristics. Total observed costs were comprised of all costs related to the hip arthroplasty and the subsequent inpatient care of the patient.

Statistical analyses were conducted to determine differences between patients in the unplanned and elective groups. None of the reviewed literature focusing on unplanned arthroplasty included a formal power analysis [2, 22, 23, 27], which could have provided insight into appropriate effect sizes. Therefore, the estimated effect size was derived per the researchers' calculation: the patient numbers in each group were sufficient to meet the parameters of a Type I error rate of 0.05 and a power of 0.80 with a standardized medium-sized difference [19]. Categorical data, including demographic information, insurance status, admission day, procedure type, diagnosis, severity of admission, admission risk of mortality, relative expected mortality, mortality, intensive care unit requirements, blood transfusion requirements, and discharge status were compared using either the chi-square or Fisher's exact tests. Chi-square tests were used in the comparison of larger groups that met criteria requiring that 80% of cells in the chi-square expected values table had a number greater than five patients. When comparing smaller groups in which this criterion was not satisfied, Fisher's exact test

was used. The Mann-Whitney test was used to compare quantitative data that were not normally distributed, including age, expected and observed length of stay, expected and observed mortality data, and all cost measures; these results were expressed as a median with a corresponding interquartile range. Statistical analysis was completed using the VassarStats® statistical software package (Richard Lowry, Vassar College, Poughkeepsie, NY, USA) [15]. In all analyses, a *p* value less than 0.05 was considered significant.

Results

All cost measures were significantly higher in patients who underwent hip arthroplasty on an unplanned basis. The median direct cost of USD 13,474 (USD 11,397–20,958) observed in the patients treated on an unplanned basis was 20% greater than the median cost of USD 11,152 (USD 10,253–12,477) for patients treated electively (*p* < 0.0001; Table 1). Additionally, the median total cost for patients treated on an unplanned basis of USD 18,206 (USD 15,261–27,491) was more than USD 3500 greater than the median of USD 14,644 (USD 13,511–16,309) for those undergoing elective procedures (*p* < 0.0001). The median total charges of USD 100,097 (USD 79,396–136,700) also were significantly greater (*p* < 0.0001) in the cohort with unplanned procedures in comparison to the USD 76,618 (USD 70,608–8,585) median of patients having elective procedures. Subgroup analysis controlling for patient age also showed a significantly (*p* = 0.007) increased median total cost of USD 18,206 (USD 14,998–24,876) for patients with unplanned admissions in comparison to the median of USD 14,834 (USD 13,548–17,895) for patients with elective admissions (Table 2). Subgroup analysis limited to in-system patients showed increased median total costs for patients with unplanned admissions; however, this difference failed to reach significance (*p* = 0.06).

Unplanned admissions were associated with longer and more complicated clinical courses and were responsible for higher costs and charges associated with care of these patients. Patients treated urgently were admitted to the intensive care unit three times as often (*p* < 0.001; Table 1), had a higher observed relative expected mortality score (*p* < 0.0001), and required blood transfusions nearly twice as often as patients admitted electively (*p* = 0.001). In-hospital mortality did not differ between the groups (*p* = 1.0) with an overall mortality rate of 0.2%. The median length of stay of 5 days for patients with an unplanned admission was longer than the 3-day median stay for patients with an elective admission (*p* < 0.0001). Patients in the unplanned and elective cohorts had similar discharge statuses, because nearly all required ongoing

Table 1. Postoperative outcomes and cost metrics between patients in elective and unplanned groups

Variable	Elective cohort	Unplanned cohort	p value
Length of stay (days)*	3 (3–4)	5 (4–9)	< 0.0001
Intensive care unit stay required [†]			
Yes	10% (37)	30% (17)	< 0.0001
No	90% (325)	70% (40)	
In-hospital mortality [‡]			1.0
Yes	0.3% (1)	0.0% (0)	
No	99.7% (361)	100.0% (57)	
Blood transfusion required [†]			0.001
Yes	23% (82)	44% (25)	
No	77% (280)	56% (32)	
Discharge status [‡]			0.37
Skilled nursing facility	97.5% (351)	100.0% (57)	
Home	2.5% (9)	0.0% (0)	
Relative expected mortality observed (2011 model)*	0.00265 (0.00265–0.00265)	0.00352 (0.00265–0.00352)	< 0.0001
Direct cost expected (USD)*	13,300 (12,256–15,274)	16,370 (13,684–18,969)	< 0.0001
Direct cost observed (USD)*	11,152 (10,253–12,477)	13,474 (11,397–20,958)	< 0.0001
Total cost observed (USD)*	14,644 (13,511–16,309)	18,206 (15,261–27,491)	< 0.0001
Total charges observed (USD)*	76,618 (70,608–88,585)	100,097 (79,396–136,700)	< 0.0001

* Mann-Whitney U test expressed as median (interquartile range); [†]chi-square test expressed as percentage (number of patients); [‡]Fisher's exact test expressed as percentage (number of patients).

Table 2. Subgroup analyses with respect to in-system status and age

Variable	Elective admission In-system patients (N = 357)	Unplanned admission In-system patients (N = 16)	p value
Age* (years)	59 (51–66)	64 (49.8–70)	0.52
Private insurance [†]	36% (129)	13% (2)	0.05
Major severity on admission [‡]	15% (52)	19% (3)	0.72
Blood transfusion required [†]	23% (82)	44% (7)	0.07
Length of stay* (days)	3 (3–4)	4 (3–5.8)	0.007
Total cost observed* (USD)	14,626 (13,510–16,297)	16,866 (14,476–19,689)	0.06
	Patients 65 and older (N = 116)	Patients 65 and older (N = 27)	
Age* (years)	70.5 (67–76.3)	74 (68–80.5)	0.21
Private insurance [†]	14% (16)	7% (2)	0.52
Major severity on admission [‡]	22% (26)	26% (7)	0.7
Blood transfusion required [†]	32% (37)	44% (12)	0.22
Length of stay* (days)	3 (3–4)	6 (5–9.5)	< 0.0001
Total cost observed* (USD)	14,834 (13,548–17,895)	18,206 (14,998–24,876)	0.007

* Mann-Whitney U test expressed as median (interquartile range); [†]chi-square test expressed as percentage (number of patients); [‡]Fisher's exact test expressed as percentage (number of patients).

Table 3. Preoperative severity scoring and mortality measures between elective and unplanned patient cohorts

Variable	Elective cohort	Unplanned procedure cohort	p value
Severity on admission*			< 0.0001
Major	15% (54)	39% (22)	
Moderate	48% (174)	47% (27)	
Mild	37% (134)	14% (8)	
Admission risk of mortality*			< 0.0001
Major	0.6% (2)	11% (6)	
Moderate	16% (58)	28% (16)	
Minor	83% (302)	61% (35)	
Length of stay expected (days) [†]	3.5 (3.2–4.0)	6.1 (4.5–6.9)	< 0.0001
Relative expected mortality*			< 0.0001
Well greater	0.6% (2)	21% (12)	
Greater	3.9% (14)	42% (24)	
Equal to	1.4% (5)	1.8% (1)	
Less than	72% (259)	33% (19)	
Well less than	23% (82)	1.8% (1)	
Mortality expected (2011 model) [†]	0.00067 (0.00067–0.00105)	0.00449 (0.00266–0.01359)	< 0.0001

* Chi-square test expressed as percentage (number of patients);

[†]Mann-Whitney U test expressed as median (interquartile range).

treatment at outside facilities ($p = 0.37$). The severity of illness on admission, admission risk of mortality, and relative expected mortality were all greater for patients with unplanned admissions ($p < 0.0001$ for all; Table 3). Quantitative predictions of mortality also were greater for patients with unplanned admissions ($p < 0.0001$). Sub-group analyses showed that when controlling for age and transfer status, the length of unplanned admissions was still significantly longer ($p < 0.0001$, and $p = 0.007$, respectively; Table 2).

Femoral fractures and periprosthetic complications were more common diagnoses in patients with unplanned admissions, whereas osteoarthritis and avascular necrosis were more prevalent in patients admitted electively. The diagnoses of femoral fracture, periprosthetic fracture, prosthetic infection, and prosthetic dislocation were all observed at significantly higher rates in patients in the unplanned surgery cohort ($p < 0.0001$, $p = 0.01$, $p = 0.005$, and $p < 0.0001$, respectively; Table 4). Diagnosis rates of osteoarthritis and avascular necrosis were significantly greater in patients in the elective cohort ($p < 0.0001$, $p = 0.02$), whereas rates of prosthetic mechanical complications such as loosening were similar between groups

Table 4. Admission type by procedure and diagnosis

Variable	Treated electively	Unplanned surgery
Procedure type		
Primary	93% (297)	8% (24)
Revision	66% (65)	34% (33)
Admission diagnosis		
Osteoarthritis/arthrosis	96% (237)	4% (9)
Femoral fracture	0% (0)	100% (12)
Aseptic necrosis	98% (43)	2% (1)
Prosthetic mechanical complication	86% (32)	14% (5)
Periprosthetic fracture/osteolysis	55% (6)	46% (5)
Prosthetic infection	64% (14)	36% (8)
Prosthetic dislocation	42% (11)	58% (15)
Other	90% (19)	10% (2)

Values expressed as percentage (number of patients).

($p = 1.0$). Regarding overall distribution of cases, 7.5% of all primary surgeries and 34% of all revision surgeries were completed on an urgent basis (Table 4). Patients with femoral fractures and prosthetic dislocations most often were treated urgently as part of an unplanned admission whereas patients with all other diagnoses were treated electively in the majority of cases. Diagnoses that were treated urgently included femoral fracture (100%) and prosthetic dislocation (57.7%). Rates of urgent surgery for patients with all other diagnoses, including osteoarthritis (3.7%), avascular necrosis (2.3%), prosthetic mechanical complications (13.5%), periprosthetic fracture (45.5%), and prosthetic infection (36.4%), were less than 50%. For patients with these diagnoses, the majority were treated electively in our system.

Patients undergoing unplanned hip arthroplasties were older and less likely to have commercial insurance than patients presenting for an elective admission. The patients undergoing unplanned arthroplasties were not significantly different from the patients having elective arthroplasties with respect to sex ($p = 0.68$) and race ($p = 0.56$) (Table 5). The median age of 63 years (range, 54–74 years) for patients in the unplanned admission cohort was greater than the median age of 59 years (range, 51–67 years) for the patients in the elective admission cohort ($p = 0.04$). With respect to insurance type, the urgently treated patients had significantly lower ($p < 0.0001$) rates of private or commercial insurance compared with patients treated electively. Urgently treated patients had significantly higher ($p = 0.001$) rates of Medicare coverage. Admission source also differed between groups with 29% of patients in the unplanned admission cohort being transferred or referred to our hospital for care in comparison to only 1% of patients in the elective admission cohort ($p < 0.0001$). Revision

Table 5. Demographics, insurance status, and admission data for elective and unplanned patient groups.

Variable	Elective cohort	Unplanned procedure cohort	p value
Age (years)*	59 (51–67)	63 (54–74)	0.04
Sex†			0.68
Female	50% (182)	47% (27)	
Male	50% (180)	53% (30)	
Race‡			0.57
White	52% (189)	48% (27)	
Non-white	48% (172)	52% (29)	
Admission source†			< 0.0001
In-system	99% (357)	29% (16)	
Transfer	0.6% (2)	71% (39)	
Primary insurance type			< 0.0001
Commercial†	36% (130)	7% (4)	0.26
Medicaid†	23% (83)	30% (17)	0.001
Medicare†	40% (144)	63% (36)	0.62
Other‡	1.4% (5)	0.0% (0)	
Procedure type†			< 0.0001
Primary	82% (297)	42% (24)	
Revision	18% (65)	58% (33)	
Admission diagnosis			
Osteoarthritis/arthrosis†	66% (237)	16% (9)	< 0.0001
Femoral fracture‡	0.0% (0)	21% (12)	< 0.0001
Aseptic necrosis†	12% (43)	1.8% (1)	0.02
Prosthetic mechanical complication†	9% (32)	9% (5)	1.0
Periprosthetic fracture/osteolysis‡	1.7% (6)	9% (5)	0.01
Prosthetic infection‡	3.9% (14)	14% (8)	0.005
Prosthetic dislocation‡	3.0% (11)	26% (15)	< 0.0001
Other‡	5% (19)	3.5% (2)	0.8

* Mann-Whitney U test expressed as median (interquartile range);

†chi-square test expressed as percentage (number of patients);

‡Fisher's exact test expressed as percentage (number of patients).

procedures made up a significantly greater ($p < 0.0001$) proportion of unplanned procedures.

Discussion

Emergent surgery has long been recognized as a risk factor for poor outcomes [7, 10, 13, 20, 26]. Although hip arthroplasties rarely are performed on a truly emergent basis, a large number are performed on an urgent or unplanned basis [27]. The true risk of an unplanned arthroplasty remains unclear, because studies have reported conflicting results regarding the possibility of increased mortality rates [22, 23, 27]. Additionally, the financial impact of unplanned procedures is largely unstudied with only one study suggesting increased charges for revision hip arthroplasty [22].

In the context of patients undergoing increasingly complicated arthroplasties [11, 14] and decreasing reimbursement rates [18], it is imperative to understand the true risks of unplanned surgery and to clarify the financial and clinical burdens associated with the care of these patients. We sought to compare demographic and insurance data, admission diagnoses, perioperative outcomes, and institutional costs between patients undergoing unplanned and elective hip arthroplasties. We specifically sought to determine (1) the institutional costs associated with unplanned (urgent) hip arthroplasty; (2) if the urgency of surgery (urgent/unplanned versus elective) influences perioperative outcomes, such as mortality, length of stay, or need for advanced care; (3) which diagnoses are associated with unplanned surgery and most often are treated urgently; and (4) if demographics and insurance status differ between admission types.

Our study was limited by its use of administrative coding data to define diagnoses. Similarly our cost and outcome data extend only to discharge from the hospital and do not account for important costs, outcomes, and readmissions that may occur after discharge. Moreover, there was an increased proportion of transferred patients in the unplanned admission cohort, and evidence suggests that transferred general orthopaedic patients may be associated with more severe injuries [1, 17]. However, transferred patients represent as much as 20% of the patient census at a specialty hospital [25], and these patients should be included when considering the impact of unplanned arthroplasties on hospital systems. Although we have completed subgroup analyses that show similar trends in length of stay and costs of unplanned admissions to attempt to control for obvious confounders, including age of patient and transfer status, a multivariate analysis would be necessary in a future study of unplanned arthroplasties. It may be difficult without large patient numbers to discern between certain variables that track together (eg, age and Medicare payer status). Nevertheless, our data realistically represent the profile of unplanned and elective arthroplasties at a tertiary medical center and provide important overall trends regarding the burdens of caring for these patients. Although insurance status of each patient was known, more research is needed to define the exact reimbursement rates according to payer status to determine the ultimate financial impact on hospitals. Despite advances in pain protocols and rapid rehabilitation programs during the last decade, patients at our institution are still being discharged to outside care facilities. The cause is likely multifactorial, including socioeconomic resources associated with a substantially urban population makeup. Historically, an “unfavorable” payer subgroup has existed in our tertiary referral population, ranging from 15% to 25% based on past data. A limitation of our study is the lack of formal reimbursement data to confirm the true impact of charges and costs observed.

The median direct costs and total costs accrued by our institution for patients with unplanned admissions were 20% and 24% greater, respectively, than those for elective admissions, whereas median total charges were 31% greater for patients with unplanned admissions. This trend is similar to the 19% increase in median total charges observed by Sams et al. [22] in their study of unplanned revision hip arthroplasties. The greater magnitude of increase we observed may be attributable to our inclusion of all arthroplasty procedures rather than just revision procedures, or may represent differences in hospital billing procedures. These numbers substantiate previously raised concerns that tertiary care hospital systems, to which transferred, unplanned admissions make up a substantial portion of the patient population, need to be reimbursed more for complex procedures and to ensure that patients continue to have access to an urgent arthroplasty [23]. Similarly, any attempt to bundle payments for arthroplasties should consider whether the surgery was performed on an elective or unplanned basis and structure payments accordingly. Attempts at risk stratification in payment models should represent the complexity of patients transferred to tertiary arthroplasty centers, as to alleviate the financial burden associated with this subgroup of patients. Although the total costs and charges of patients with unplanned admissions in our study were substantially greater than for patients with elective admissions, further studies are necessary to look at actual reimbursement data to understand the overall financial impact of providing unplanned arthroplasties.

Patients undergoing an unplanned arthroplasty had significantly higher predicted and observed morbidity measures. Physicians admitting these patients not only scored higher morbidity and mortality risks, but patients undergoing unplanned arthroplasties were observed to have 67% longer hospital stays, require blood transfusions nearly twice as often, and were admitted to the intensive care unit three times as often as patients admitted for elective arthroplasties. These trends are consistent with prior studies, suggesting that patients undergoing an unplanned procedure stayed longer [22, 23] and had higher rates of postoperative hemorrhage [27]. The increased morbidity risk of an unplanned arthroplasty may become even more apparent because trends show patients undergoing an arthroplasty are presenting with increasing numbers of comorbidities [11, 14], factors themselves associated with higher morbidity and mortality rates [4]. We did not observe an increased in-hospital mortality risk, which was similar to previous trends reported by Sams et al. [23], but was in contrast to other studies [22, 27]. Our study was underpowered to fully evaluate such a rare event, and additional studies are necessary and should include large patient groups with mortality measured beyond the perioperative period.

The diagnostic rates of femoral fracture, periprosthetic fracture, prosthetic infection, and prosthetic dislocation were all significantly greater in the patients undergoing unplanned surgery, indicating that these diagnoses drive urgent arthroplasties. Although periprosthetic fractures and infections were observed at higher rates in patients in the unplanned arthroplasty cohort, from an absolute case number standpoint, patients with these diagnoses were still treated electively in the majority of cases. Interestingly, only femoral fractures and prosthetic dislocations were observed to be treated urgently in the majority of cases. In our study, 100% of femoral fractures were addressed on an urgent basis, a strategy consistent with the current literature highlighting the role of urgent management for this subset of patients [3, 6, 24]. During our study, 33.7% of revision procedures were performed urgently, a number notably higher than the 14.9% rate observed by Sams et al. [23] and the 22% rate reported by Zhan et al. [27]. This discrepancy could be the result of different treatment strategies for revision procedures or differences in type and case complexity seen at various institutions. In aggregate, the 13.6% rate of unplanned arthroplasties at our institution indicates that these cases represent a substantial portion of case volume.

We observed that patients treated urgently in our hospital tended to be older than those undergoing elective procedures, similar to trends reported previously [2, 22, 23]. This difference is important, because it has been observed that older patients are susceptible to higher morbidity and mortality rates [16, 23, 27]. The older median age of patients in the unplanned arthroplasty cohort may be the result of the high number of patients with femoral fractures in the group, a diagnosis that is associated with older age [5], and/or a higher number of revision procedures. Our transferred patients were associated with an unplanned arthroplasty, a trend that is likely influenced by the ability of our Level I trauma and adult reconstruction specialty center to accept the most critical and urgent cases. Alternatively this could represent an unwillingness of community hospitals to perform unplanned procedures (including procedures in patients evaluated outside of workweek times) or procedures with increased complexity. Commercial insurance was associated with elective procedures, whereas Medicare coverage was observed at higher rates in patients in the unplanned admission cohort. This trend may be the result of the different diagnostic makeup of the cohorts but raises the concern that insurance coverage may be a factor contributing to unplanned admissions.

From this study, the well-known risks of emergent surgery also apply to urgent, unplanned arthroplasties. Across most measures, including length of stay, morbidity, and costs, unplanned arthroplasties carry significant clinical and financial burdens to treating institutions. Further

studies are necessary to elucidate the mortality risks and payer, reimbursement, and readmissions issues. This initial study prompts the need for further research to understand the indications for unplanned procedures and to develop treatment algorithms to effectively manage the subset of patients undergoing arthroplasties.

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