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Quantifying Non-Index Hospital Readmissions and Care Fragmentation Following Major Urologic Oncology Surgeries in a Nationally Representative Sample

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Abstract

Purpose—To quantify the underestimation of readmission rates that can occur with institutional databases and the incidence of care fragmentation among patients undergoing urologic oncology procedures in a nationally representative database.

Materials and Methods—The 2013 Nationwide Readmissions Database was queried for patients undergoing prostatectomy, cystectomy, nephroureterectomy, nephrectomy, partial nephrectomy, and retroperitoneal lymph node dissection for urologic malignancies. Nationally representative 30-day and 90-day readmission and care fragmentation rates were calculated for all procedures. Readmission rates with and without non-index hospital readmissions were compared with Pearson's chi-square test. Multivariable logistic regression models were used to identify predictors of care fragmentation at 90-day follow-up.

Results—Among all surgical procedures, readmission rates were consistently underestimated by 17-29% at 90-day follow-up. The rates of care fragmentation among readmitted patients were similar for all procedures ranging from 24-34% at 90-day follow-up. Overall, 1 in 4 readmitted patients would not be captured in institutional databases and 1 in 3 readmitted patients experienced care fragmentation. Multivariable models did not identify a predictor of care fragmentation that was consistent across all procedures.

Conclusion—The high rate of underestimation of readmission rates across all urologic oncology procedures highlights the importance of linking institutional and payer claims databases to provide more accurate estimates of perioperative outcomes and care utilization. The high rate of care fragmentation across all procedures underlines the need for future efforts to understand the clinical relevance of care fragmentation in urologic oncology patients and to identify patients at risk along with potentially modifiable risk factors for care fragmentation.

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Keywords

patient readmissions; urologic surgical procedures; postoperative care; continuity of care

Introduction

Postoperative readmission rates are an important quality metric that has been widely adopted by the urologic community.¹⁻² A well-known limitation of studies reporting readmission rates based on institutional databases is the inability to capture readmissions at outside (non-index) hospitals, resulting in an underestimation of the true readmission rate.³⁻⁴ Researchers have recently started quantifying this problem by investigating the rate of non-index hospital readmissions in patients undergoing major cancer surgeries. These studies have reported 19-33% of readmitted patients are readmitted to a non-index hospital.⁵⁻⁸

Beyond non-index hospital readmissions being problematic for accurately reporting readmission rates, they also lead to care fragmentation, which is associated with worse perioperative outcomes for surgical patients.⁷⁻¹³ As a result, it is important for urologists to quantify the burden of care fragmentation experienced by their patients as it represents a target for quality improvement.

Therefore, the objectives of this study were three-fold. First, determine the incidence of non-index hospital readmissions for patients undergoing major urologic oncology surgeries in a nationally representative sample. Second, quantify the effect of excluding non-index readmissions on reported readmission rates. Finally, quantify the rates of care fragmentation experienced by patients following urologic oncology surgeries and identify predictors of care fragmentation.

Methods

Data Source

The Nationwide Readmissions Database (NRD) is drawn from the same sample of discharges as the Nationwide Inpatient Sample that are linked to 21 State Inpatient Databases from the Healthcare Cost Utilization Project, Agency for Healthcare Research and Quality.¹⁴ The NRD was created this year with only data available for the 2013 calendar year, and provides a unique opportunity to study hospital readmissions in a database that contains both Medicare and non-Medicare patients. The NRD provides patient linkage and hospital identification (ID) numbers that can be used to track a patient across hospitals within a state. Moreover, the NRD is a stratified, single-stage cluster sample of hospital discharges with weights that can be used to provide nationally representative estimates of readmission counts.

Patient Cohort

With Institutional Review Board approval from the Johns Hopkins Medical Institution, the 2013 NRD was queried using ICD-9 codes to identify patients who underwent cystectomy (57.71, 57.79) for bladder cancer (188.x, 233.7), prostatectomy (60.5) for prostate cancer

(185), nephrectomy (55.5x) for renal cancer (189.0), partial nephrectomy (55.4) for renal cancer, retroperitoneal lymph node dissection (RPLND, 40.29, 40.3, 40.52, 40.59, 59.00) for testicular cancer (186.x), nephroureterectomy (55.51) for renal pelvis or ureteral cancers (189.1, 189.2). The hospitalization with the oncologic resection was the initial hospitalization and the hospital the resection took place in was the index hospital.

We excluded patients with metastatic disease during the initial hospitalization for all cancers (19.7x, 19.8x) and testicular cancer patients with chemotherapy administration (99.25, 99.28, V58.1x, E933.1) or autologous stem cell transplant (41.04) during initial hospitalization. Individuals who died during their initial hospitalization were excluded since they were not at risk for readmissions. Individuals that were not residents of the state in which the initial hospitalization took place were excluded since they would most likely be readmitted in their state of residence, which would not be captured in the NRD. For the calculation of 30-day and 90-day readmission counts, patients discharged after November and after September were excluded since they could not be observed in the NRD for the full 30-day and 90-day follow-up periods, respectively.

Sociodemographic and Hospital Variables

Patient- and hospital-level exposure variables included age, gender, length of stay, primary payer, median household income national quartile for patient's home ZIP code, hospital location, hospital bed size, and patient disposition at discharge. A Charlson comorbidity index was calculated with a previously validated algorithm that uses ICD-9 diagnosis codes from the initial hospital discharge.¹⁵ This was modified to exclude points due to cancer as all patients in this cohort had a cancer diagnosis. For each procedure, the hospital procedure volume was determined to be low (< 50th percentile), intermediate (>50 to <80th percentile), or high (>80th percentile).

Surgical and Complication Variables

An open surgical approach was assumed for all procedures unless ICD-9 codes were present to indicate minimally invasive surgical approaches (54.21, 54.51, 17.4x). Complications during the initial hospitalization were identified using ICD-9 codes (Supplementary Table 1). For cystectomy patients, ICD-9 codes were used to categorize the urinary diversion as an ileal conduit (56.51, 56.71), a continent diversion (57.87), ureterostomy (56.61), or unknown.¹⁶

Outcomes

Patients were identified as having a 30-day or 90-day readmission if the duration from the initial hospitalization discharge to a subsequent admission was 30 days or 90 days, respectively. These time points were chosen because they are commonly reported in the urologic oncology literature as outcome measures.^{11, 17}

Index readmissions were defined as readmissions for which the hospital ID number for the initial hospitalization discharge and readmission discharge were identical. Non-index readmissions were defined as readmissions for which the hospital ID number for the initial hospitalization discharge and readmission discharge were different.

For each procedure, patients were then stratified into four readmission groups based on their pattern of readmissions. The groups were patients who experienced 1) only an index hospital readmission, 2) only a non-index hospital readmission, 3) both an index and non-index hospital readmission, and 4) did not have a readmission during the follow-up period. This was done for both 30-day and 90-day follow up durations. Patients with a transfer from a non-index to index hospital during their readmission were classified as patients that experienced an index hospital readmission. This approach was chosen because the Centers for Medicare and Medicaid Services consider transfers as a single readmission.

Statistical Analysis

Sociodemographic, hospital, and surgery characteristics were calculated for each procedure. Next, for each oncologic procedure, the 30-day and 90-day readmission rates were calculated by combining the counts of all readmissions (readmission groups 1, 2, and 3).

To quantify the underestimation of readmissions that would occur if only index hospital readmissions were captured in a database, the proportion of 30-day and 90-day readmitted patients (groups 1, 2, and 3) that were readmitted to only a non-index hospital (group 2) was calculated for each procedure. Patients with both an index and non-index hospital readmissions (group 3) were not included in the numerator of this calculation, as the index hospital database would capture a readmission for those patients. In order to compare whether the readmission rates were different with and without the underestimation, the Pearson's chi-square was calculated comparing the two rates for both the 30-day and 90-day timeframes.

To quantify the number of readmitted patients that experienced care fragmentation, the counts of the patients that had both index and non-index hospital readmission (group 3) and the only non-index hospital readmission group (groups 1) were combined and divided by the total number of readmissions for a procedure (groups 1, 2, and 3).

Next, sociodemographic, hospital, and surgery characteristics were calculated for each procedure stratified by whether patients experienced care fragmentation during the 90-day follow-up period. Then univariable and multivariable logistic regression models were used to determine predictors of experiencing care fragmentation during the 90-day follow-up period. These statistics were not calculated for RPLND due to the low absolute number of events in this group. For all analyses, the appropriate weights were applied to take into account the stratified, single-stage cluster sample design of the NRD to yield nationally representative estimates. All analyses were conducted using STATA version 14 (StataCorp, College Station, Texas). All reported p-values were 2 sided and a p-value 0.05 was considered statistically significant for all tests.

Results

With weighting there were 48,267 prostatectomies, 6173 cystectomies, 3371 nephroureterectomies, 18541 nephrectomies, 12135 partial nephrectomies, and 382 RPLNDs meeting inclusion criteria. Sociodemographic, hospital, and surgery characteristics

for each procedure are shown in Table 1 and stratified by whether patients experienced care fragmentation at 90-day follow-up in Supplementary Table 2.

Quantifying Underestimation

Across all surgical groups, readmission rates were consistently underestimated by 17-29% at 90-day follow-up (Table 2 and Figure 1). At both 30-day and 90-day follow-up the rates of underestimation was quite similar between the different procedures, except for RPLND which had much lower rates of underestimation at both time points.

The 30-day and 90-day readmission rates with vs. without underestimation are listed in Table 3. For all procedures there was a significant difference (all $p < 0.05$) between the two readmission rates at both 30- and 90-days.

Quantifying Care Fragmentation

Across all surgical groups, the rates of care fragmentation among readmitted patients ranged from 24-34% at 90-day follow-up (Table 2 and Figure 1). At both 30-day follow-up and 90-day follow-up the rates of care fragmentation among readmitted patients were similar between the different procedures except RPLND at 30-day follow-up which had a much lower rate of care fragmentation.

Predictors of Care Fragmentation

Multivariable models for predictors of care fragmentation at 90-day follow-up were evaluated by surgery (Supplementary Table 3). Of note, there were no variables that were predictors of care fragmentation across all surgeries.

Discussion

This study provides the first nationally representative estimates of the rates of hospital readmissions to index and non-index hospitals for patients undergoing major urologic oncologic surgeries, yielding both the magnitude of underestimation of readmission rates that occurs in institutional databases and the rate of care fragmentation experienced by urologic oncology patients in the perioperative period. For all procedures the underestimation of readmission rates and the rate of care fragmentation was found to be very similar highlighting the importance and large burden of these problems for all urologic oncology procedures.

The extent of underestimation of readmission rates was very similar for all procedures, excluding RPLND, at both 30-day (17-24%) and 90-day (23-29%) follow-up. At 30-day follow-up 1 out of every 5 and at 90-day follow-up 1 out of every 4 readmitted urologic oncologic surgery patients would be missed by institutional databases that are unable to capture non-index hospital readmissions. The readmission rates with vs. without underestimation were significantly different for all procedures at both 30-day and 90-day follow-up. While the statistical significance of these difference is likely due to the large sample associated with nationally representative estimates, these results still highlight the need to link institutional databases containing clinical data to payer databases with claims

data to better understand healthcare utilization and outcomes following discharge from the initial hospitalization.

The ability of urologic surgeons to accurately measure healthcare utilization is especially important given the transition from volume- to value-based purchasing.¹⁸ Providers will be assuming increasing risk under the statutory mandates in the Medicare Access and CHIP Reauthorization Act of 2015, and these federal efforts will have a ripple effect across all payers. Therefore, for providers to develop and participate in payment models that accurately predict the risk of care utilization and spending will require an accurate assessment of readmission rates. Notably, the Centers for Medicare & Medicaid Services currently does not distinguish between readmissions at the index or non-index hospital when measuring performance on readmission measures for the Hospital Readmission Reduction Program.¹⁹

In this study, at 90-day follow-up care fragmentation occurred in almost 1 in 3 of every readmitted urologic oncology patients. Care fragmentation was the highest for readmitted cystectomy patients (36.2% at 90-day follow-up), and this rate is consistent with findings from previous studies.^{7, 11, 20} Therefore, cystectomy patients represent a population of particular interest for future studies on the clinical implications of care fragmentation. However, the rates of care fragmentation were very similar for all procedures, except RPLND at 30-day follow-up, which indicates care fragmentation is equally problematic for all readmitted urologic oncology surgical patients. This is especially important in light of the current trends towards regionalization of urologic oncology surgeries, which affords the benefit of having patients treated by high-volume surgeons at high-volume centers, but can expose patients to the harms associated with fragmentation of care as they travel farther for their initial surgery.^{5, 7-13, 21-22} This effect of regionalization leading to increased care fragmentation is supported from our finding that high-volume hospitals had a greater likelihood of care fragmentation compared to lower volume hospitals. Previous studies in surgical patient populations have demonstrated that care fragmentation is associated with higher rates of in-hospital mortality, subsequent readmissions, increased costs with readmission, and higher rates of 1-year mortality.⁷⁻¹³ However, it is important to realize there are certain instances in which non-index readmissions may be preferred. For example, patients who travel long distances to undergo complex procedures at centers of excellence would likely prefer to be readmitted locally at non-index institutions as long as outcomes are comparable.

We were unable to identify a predictor of care fragmentation that was consistent for all urologic oncology procedures, highlighting that urologic oncology patients represent a diverse patient population with a different set of challenges for each procedure. Of note, high procedure volume, transfers to a facility, and increased LOS were associated with increased odds of care fragmentation in at least 1 procedure, which represent potentially modifiable risk factors. Moving forward, it will be important to identify potentially modifiable risk factors that predispose patients to experiencing care fragmentation. These “actionable” risk factors can then be modified through interventions to improve quality of care.

There are several limitations to this study. First, this study was done with an administrative database that does not contain pathologic information about the cancers that were treated. However, we excluded patients with metastatic disease at the time of their initial hospital discharge as these patients are often excluded in studies investigating outcomes of urologic oncology patients undergoing surgical resection. Additionally, we excluded non-residents of states in this study because the NRD only captures readmissions within a given state. As a result, our estimation of care fragmentation for these procedures is likely still an underestimate since non-residents are more likely to experience a readmission to a non-index hospital located in the state they reside in. Additionally, the NRD does not contain variables related to regional variation, patient travel distance to hospital, surgeon volume, or National Cancer Institute cancer center designation. These are important factors that future studies on care fragmentation should investigate. In addition, we were unable to investigate the number of Emergency Department encounters that did not result in readmissions, which further highlights the need to merge claims data with clinical outcomes data. Moreover, in this study we did not look at the outcomes of patients during hospital readmission or causes of readmissions as this was outside of the aims of this study.

Conclusions

One out of every 4 readmitted urologic oncologic surgery patients will only be readmitted to a non-index hospital, while 1 in every 3 will experience care fragmentation. These findings highlight the need for databases that merge payer claims data with clinical information, and the importance of improving urologic oncology quality vis a vis care fragmentation. Future research should focus on increasing our understanding of the clinical relevance and policy implications of care fragmentation as it represents an important quality of care metric that has not yet been evaluated for these urologic oncology procedures despite the fact that many urologic oncologic surgery patients are experiencing care fragmentation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Abbreviations

NRD	Nationwide Readmission Database
ICD	International Classification of Diseases
ID	identification
RPLND	retroperitoneal lymph node dissection
CI	confidence interval
OR	odds ratio

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Figure 1.

a (Left). Proportion of 30-day readmissions to index and non-index hospital by oncologic procedure. Blue area represents underestimation of readmission rates in conventional databases. Blue + red area represents patients experiencing care fragmentation.

b (Right). Proportion of 90-day readmissions to index and non-index hospital by oncologic procedure. Blue area represents underestimation of readmission rates in conventional databases. Blue + red area represents patients experiencing care fragmentation.

Table 1

Sociodemographic and Hospital Characteristics For Each Procedure for Patients with 30-day follow-up.

	Prostatectomy (n=48267)	Cystectomy (n=6173)	Nephroureterectomy (n=3371)	Nephrectomy (n=18541)	Partial Nephrectomy (n=12135)	RPLND (n=382)
Mean Age (SE)	62.0 (0.1)	68.5 (0.2)	71.7 (0.3)	62.1 (0.3)	59.4 (0.3)	32.1 (0.8)
Sex						
- Male	100%	81.6%	60.9%	61.7%	62.2%	100%
- Female	0%	18.4%	39.1%	38.3%	37.8%	0%
Charlson Comorbidity Index						
- 0	74.6%	49.9%	46.2%	49.5%	55.1%	87.7%
- 1	20.0%	24.2%	24.4%	24.1%	25.0%	8.8%
- 2	5.4%	25.9%	29.4%	26.4%	19.8%	3.5%
Insurance						
- Medicare	36.6%	64.9%	74.8%	50.4%	37.7%	5.3%
- Non-Medicare	63.4%	35.1%	25.2%	49.6%	62.3%	94.7%
Patient Location						
- >1 million	51.8%	48.6%	47.3%	46.7%	56.4%	57.8%
- 250,000-1 million	21.1%	21.5%	22.3%	22.4%	18.6%	18.5%
- 50,000-250,000	10.5%	12.2%	11.6%	11.2%	9.4%	10.4%
- <50,000	9.6%	10.1%	12.3%	11.5%	9.0%	6.4%
- Not Metro/Micropolitan	7.0%	7.6%	6.5%	8.2%	6.7%	6.9%
Disposition						
- Routine	95.8%	29.4%	70.8%	86.2%	91.5%	94.7%
- Transfers to Facility	0.3%	11.8%	11.1%	5.2%	2.1%	<2%
- Home Health	3.9%	58.8%	18.1%	8.6%	6.4%	4.9%
Surgical Approach						
- Open	20.2%	75.7%	61.9%	70.4%	44.4%	90.2%
- Minimally Invasive	79.8%	24.3%	38.1%	29.6%	55.6%	9.8%

	Prostatectomy (n=48267)	Cystectomy (n=6173)	Nephroureterectomy (n=3371)	Nephrectomy (n=18541)	Partial Nephrectomy (n=12135)	RPLND (n=382)
Index Hospital Location						
- Metropolitan	96.3%	97.0%	94.0%	94.7%	96.9%	98.9%
- Non-metropolitan	3.7%	3.0%	6.0%	5.3%	3.1%	1.1%
Length of Stay (SE)	1.8 (0.04)	10.1 (0.2)	5.4 (0.1)	4.8 (0.08)	3.8 (0.09)	5.4 (0.3)
Number of 30-Day Readmissions						
- 0	96.0%	71.6%	89.6%	91.0%	90.3%	85.1%
- 1	3.6%	24.0%	9.5%	7.9%	8.8%	14.0%
- 2	0.3%	4.0%	0.7%	0.9%	0.9%	0.9%
- 3+	0.1%	0.4%	0.2%	0.2%	<0.1%	0%
Number of 90-Day Readmissions Among						
Patients with 90-Day Follow-up						
- 0	94.6%	59.6%	82.4%	84.7%	86.7%	81.1%
- 1	4.8%	25.4%	13.9%	12.0%	11.4%	12.5%
- 2	0.6%	10.3%	2.6%	2.2%	1.6%	3.2%
- 3+	<0.1%	4.7%	1.1%	1.1%	0.3%	3.2%

Table 2
Thirty-day and ninety-day estimates of underestimation of readmission rates and care fragmentation.

	Percentage of Individuals (Numerator/Denominator)					
	Prostatectomy	Cystectomy	Nephroureterectomy	Nephrectomy	Partial Nephrectomy	RPLND
30-Day Underestimation of Readmission Rates	22.3% (429/1927)	18.5% (325/1754)	24.0% (84/350)	23.2% (383/1664)	17.4% (204/1175)	12.3% (*/*)
30-Day Care Fragmentation Rate	23.8% (458/1927)	23.7% (415/1754)	24.6% (86/350)	25.6% (426/1664)	19.2% (226/1175)	12.3% (*/*)
90-Day Underestimation of Readmission Rates	28.5% (613/2154)	23.0% (465/2018)	27.5% (131/476)	26.7% (615/2307)	25.0% (326/1303)	17.5% (*/*)
90-Day Care Fragmentation Rate	30.7% (662/2154)	33.7% (681/2018)	32.1% (153/476)	31.2% (720/2307)	27.3% (356/1303)	24.6% (*/*)

CI- confidence interval

RPLND- retroperitoneal lymph node dissection

* Exact number of patients is not reported to maintain patient confidentiality

Table 3

Comparison of 30-day and 90-day readmission rates with and without non-index hospital readmission information.

	Readmission rate without non-index readmission information [95% CI]	Readmission rate with non-index readmission information [95% CI]	Absolute Difference in Readmission rates [95% CI]	p-value
30-day Prostatectomy	3.1% [2.8, 3.4]	4.0% [3.7, 4.3]	0.9% [0.7, 1.1]	<0.001
30-day Cystectomy	23.1% [21.3, 25.1]	28.4% [26.5, 30.4]	5.3% [4.3, 6.3]	<0.001
30-day Nephroureterectomy	7.9% [6.5, 9.5]	10.4% [8.7, 12.3]	2.5% [1.6, 3.4]	<0.001
30-day Nephrectomy	6.9% [6.2, 7.7]	9.0% [8.2, 9.8]	2.1% [1.7, 2.4]	<0.001
30-day Partial Nephrectomy	7.9% [6.9, 9.0]	9.7% [8.6, 10.9]	1.8% [1.3, 2.3]	<0.001
30-day RPLND	13.2% [8.7, 19.5]	14.9% [10.1, 21.5]	1.7% [0.1, 3.3]	0.04
90-day Prostatectomy	3.9% [3.5, 4.2]	5.4% [5.0, 5.8]	1.5% [1.3, 1.8]	<0.001
90-day Cystectomy	31.1% [28.8, 33.6]	40.4% [37.8, 43.1]	9.3% [7.70, 10.9]	<0.001
90-day Nephroureterectomy	12.8% [10.8, 15.0]	17.7% [15.4, 20.2]	4.9% [3.5, 6.2]	<0.001
90-day Nephrectomy	11.2% [10.2, 12.4]	15.3% [14.2, 16.5]	4.1% [3.5, 4.6]	<0.001
90-day Partial Nephrectomy	10.0% [9.0, 11.2]	13.3% [12.2, 14.6]	3.3% [2.6, 4.0]	<0.001
90-day RPLND	15.6% [10.1, 23.4]	18.9% [12.9, 26.9]	3.3% [0.6, 6.0]	0.02

CI- confidence interval

RPLND- retroperitoneal lymph node dissection