

Original article

Assessing trends in urinary diversion after radical cystectomy for bladder cancer in the United States

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Abstract

Objectives: We assessed recent trends in both urinary diversion after radical cystectomy for bladder cancer in the United States and patient- and hospital-related characteristics. We also identified variables associated with undergoing continent diversion.

Materials and methods: We queried the National Cancer Database and identified 27,170 patients who underwent radical cystectomy with urinary diversion from 2004 to 2013. Patient demographics, socioeconomic variables, and hospital-related factors were compared between incontinent and continent diversion and trended over time. Multivariable logistic regression was used to identify variables associated with undergoing continent diversion.

Results: Overall, 23,224 (85.5%) and 3,946 (14.5%) patients underwent incontinent and continent diversion, respectively. Continent diversion declined from 17.2% in 2004 to 2006 to 12.1% in 2010 to 2013 ($P < 0.01$). When analyzing high-volume facilities, those performing $\geq 75\%$ minimally invasive radical cystectomy had fewer continent diversions (10.2%) compared to centers with higher rate of open approach (19.7%), $P < 0.01$. Higher income, facility located in the West, academic programs, high-volume facilities, and patients traveling >60 miles for care were significantly associated with undergoing continent diversion. Rate of continent diversion has declined in most patient- and hospital-related subgroups. Compared to 2004 to 2006, patients in 2010 to 2013 were more likely to be older, have more comorbidities, and be operated on at a high-volume academic facility.

Conclusion: The rate of continent diversion has declined to 12.1% in the United States. Hospital volume and type, patient income, distance traveled for care, and geography are significantly associated with undergoing continent diversion. Even among high-volume and academic centers, the rate of continent diversion is declining. © 2018 Elsevier Inc. All rights reserved.

Keywords: Bladder cancer; Radical cystectomy; Urinary diversion; Neobladder; Trends

1. Introduction

In the United States, bladder cancer will be diagnosed in an estimated 81,000 patients in 2018 [1]. Radical cystectomy (RC) with a thorough pelvic lymph node dissection is the treatment of choice for muscle-invasive bladder cancer [2,3]. Following RC, reconstruction of the urinary system

can be performed using a variety of techniques. The critical distinction of different diversion options is between incontinent diversions (ID) and continent diversions (CD), such as catheterizable continent cutaneous pouches and the most common form, the orthotopic neobladder.

Each type of diversion requires consideration of surgical technique, perioperative morbidity [4,5], and long-term quality of life outcomes [6–8]. There continues to be controversy as to which diversion is best suited for patients. Approximately 75% of patients undergoing RC are candidates for CD [9], nonetheless, the rate of CD is highly

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variable, even when comparing between high-volume, tertiary care centers [2,10]. A better understanding of trends in the performance of CD over time and critical patient- and facility-related factors driving the choice of urinary diversion (UD) is needed in order to optimize patient selection and outcomes.

The aim of this study was to analyze current trends in patterns of care for UD utilization after RC for bladder cancer in the United States. We examined trends over time in performance of CD, as well as changes in patient and facility characteristics that could be driving the evolution of practice patterns. Additionally, we assessed the relationship between minimally invasive surgery (MIS) and frequency of ID and CD. Finally, we sought to identify features associated with undergoing continent diversion using both patient- and facility-related variables.

2. Materials and methods

2.1. Data source

The National Cancer Database (NCDB) is jointly sponsored by the Commission on Cancer (CoC) of the American College of Surgeons and the American Cancer Society. The database collects oncologic data on more than 70% of new cancer cases in the United States through more than 1,500 CoC-accredited cancer programs. Data are de-identified and submitted to the NCDB by each cancer program using standardized data and coding definitions defined by the CoC's Facility Oncology Registry Data Standards. The NCDB captures information about patient demographics and socioeconomic status, cancer staging, treatments, and outcomes. Institutional review board approval was not required as patient, physician, and hospital information is de-identified in the NCDB.

2.2. Study population

We identified 27,170 patients who were diagnosed with primary bladder cancer and underwent RC with UD between 2004 and 2013. Type of UD was identified using the Participant User File bladder codes: 61 (ileal conduit), 62 (continent cutaneous reservoir or pouch NOS), 63 (abdominal pouch [cutaneous]), and 64 (in situ pouch [orthotopic]). Patients were categorized into ID (61) or CD (62–64).

2.3. Study variables

Patient demographics included age at diagnosis, sex, race, and Charlson comorbidity index (CCI). Socioeconomic covariates included insurance status (uninsured, private/managed care, Medicaid, Medicare, and other), median income by zip code based on national survey data (<\$38,000, \$38,000–\$47,999, \$48,000–\$62,999, and >\$63,000), percentage of people who did not graduate high school (<7%, 7%–12.9%, 13%–20.9%, and

>21%) by zip code, and distance traveled to hospital. Hospital variables included facility location (Northeast, South, Midwest, and West), facility type defined as non-academic or academic (minimum of 4 areas of postgraduate medical education and more than 500 newly diagnosed cancer cases each year), location type defined as metro, urban, or rural. Hospital volume was categorized into quartiles based on annual RC volume (low: 1–3 cases, low-intermediate: 4–7 cases, high-intermediate: 8–16 cases, and high: 17–98 cases). Pathologic stage was categorized by the American Joint Committee on Cancer TNM system (extent of the tumor (T), extent of spread to the lymph nodes (N), and the presence of metastasis (M)). The NCDB began capturing surgical approach in 2010 and was categorized as open MIS. We calculated the percentage of MIS RCs performed at each facility since 2010 and dichotomized the percentage of MIS RC performed into the top 90th percentile of facilities and <90th percentile. The top 90th percentile equated to $\geq 75\%$ of RCs performed by MIS.

2.4. Outcomes

The primary outcome was receipt of CD after RC, with a focus on identification of patient and facility factors associated with receiving CD. Trends in type of UD, patient, and facility characteristics were also examined comparing 3 time periods (2004–2006, 2007–2009, and 2010–2013). Surgical approach trends were analyzed annually.

2.5. Statistical analysis

Categorical variables and trends were analyzed using Pearson's chi-squared test. ANOVA test was used to analyze mean age across the study period. Variables associated with CD on univariate analysis were included in a multivariable logistic regression model. All P values were 2-sided with $P < 0.05$ considered statistically significant. Statistical analysis was performed using Stata 13 (StataCorp., College Station, TX).

3. Results

3.1. Patient-related demographics

From 2004 to 2013, there were a total of 27,170 patients who underwent RC with UD of which 23,224 (85.5%) and 3,946 (14.5%) were ID and CD, respectively (Table 1). Those aged ≤ 80 years had a CD rate of 15.8% compared to CD rate of 3.9% for patients older than 80 years, $P < 0.01$. When comparing sex, males were more likely to undergo CD compared to females (15.2% vs. 10.1%, $P < 0.01$). Patients with ≥ 1 CCI were less likely to have CD compared to patients with no comorbidities (10.5% vs. 16.3%, $P < 0.01$). There was no difference in rates of CD when comparing whites vs. non-whites, $P = 0.64$.

Table 1
Patient demographics and hospital features. Statistically significant if bold

	Incontinent diversion	Continent diversion	P
Age			<0.01
≤80	20,504 (84.2)	3,835 (15.8)	
>80	2,720 (96.1)	111 (3.9)	
Sex			<0.01
Male	19,882 (84.8)	3,571 (15.2)	
Female	3,342 (89.9)	375 (10.1)	
Race			0.64
White	21,360 (85.5)	3,638 (14.5)	
Non-white	1,864 (85.8)	308 (14.2)	
Charlson comorbidity index			<0.01
0	15,813 (83.7)	3,080 (16.3)	
≥1	7,411 (89.5)	866 (10.5)	
% of no high school graduates in patient's zip code of residence			<0.01
≥21%	3,305 (87.2)	487 (12.8)	
13%–20.9%	6,038 (86.7)	929 (13.3)	
7%–12.9%	8,043 (85.9)	1,321 (14.1)	
<7%	5,404 (82.9)	1,113 (17.1)	
Insurance status			<0.01
Not insured	640 (84.7)	116 (15.3)	
Private/managed care	6,495 (75.8)	2,075 (24.2)	
Medicaid	943 (84.2)	177 (15.8)	
Medicare	14,598 (90.7)	1,490 (9.3)	
Other	548 (86.2)	88 (13.8)	
Median income			<0.01
<\$38,000	3,763 (89.3)	453 (10.7)	
\$38,000–\$47,999	6,052 (86.8)	921 (13.2)	
\$48,000–\$62,999	6,355 (85.8)	1,056 (14.2)	
≥\$63,000	6,606 (82.3)	1,419 (17.7)	
Facility location			<0.01
Northeast	4,614 (87.2)	677 (12.8)	
South/southeast	7,742 (88.2)	1,041 (11.8)	
Midwest	7,237 (85.9)	1,189 (14.1)	
West	3,527 (78.5)	964 (21.5)	
Facility type			<0.01
Nonacademic facility	11,895 (89.8)	1,348 (10.2)	
Academic program	11,225 (81.7)	2,523 (18.3)	
Hospital volume			<0.01
Low (1–3 cases)	6,747 (89.2)	819 (10.8)	
Low-intermediate (4–7 cases)	6,327 (89.4)	748 (10.6)	
High-intermediate (8–16 cases)	5,028 (84.9)	895 (15.1)	
High (17–98 cases)	5,122 (77.5)	1,484 (22.5)	
County description			<0.01
Metropolitan	17,221 (84.8)	3,080 (15.2)	
Urban	4,496 (88.1)	610 (11.9)	
Rural	625 (89.3)	75 (10.7)	
Miles from patient's residence to hospital			<0.01
≤60	18,586 (86.5)	2,908 (13.5)	
>60	4,638 (81.7)	1,038 (18.3)	
Surgical approach			0.01
Open	6,104 (88.6)	782 (11.4)	
Minimally invasive	2,776 (86.7)	424 (13.3)	
Pathologic stage			<0.01
<pT1	1,605 (80.3)	394 (19.7)	
pT1	2,033 (81.7)	455 (18.3)	
pT2	6,531 (84.1)	1,235 (15.9)	
pT3	7,702 (87.1)	1,144 (12.9)	
pT4	3,422 (90.6)	355 (9.4)	
Surgical margin			<0.01
Negative	19,409 (84.7)	3,503 (15.3)	
Positive	2,778 (91.2)	269 (8.8)	

(continued)

Table 1 (Continued)

	Incontinent diversion	Continent diversion	<i>P</i>
Surgical approach ratio			0.37
<75% cases MIS	8,122 (87.8)	1,129 (12.2)	
≥75% MIS	1,022 (88.7)	130 (11.3)	
Surgical approach ratio (low volume)			0.14
<75% cases MIS	2,208 (91.7)	201 (8.3)	
≥75% MIS	401 (89.5)	47 (10.5)	
Surgical approach ratio (low-intermediate volume)			0.50
<75% cases MIS	2,253 (92.2)	190 (7.8)	
≥75% MIS	220 (90.9)	22 (9.09)	
Surgical approach ratio (high-intermediate volume)			0.27
<75% cases MIS	1,772 (86.6)	275 (13.4)	
≥75% MIS	199 (84.0)	38 (16.03)	
Surgical approach ratio (high volume)			<0.01
<75% cases MIS	1,889 (80.3)	463 (19.7)	
≥75% MIS	202 (89.8)	23 (10.2)	

3.2. Socioeconomic-related demographics

When comparing insurance status, patients with private/managed care had the highest rates of CD (24.2%) while Medicare had the lowest rate (9.3%), $P < 0.01$. For high school education and median income, CD diversion rates increased per quartile, $P < 0.01$. Patients living in a metropolitan county were more likely to receive CD compared to those living in a rural county (15.2% vs. 10.7%, $P < 0.01$). Furthermore, patients traveling >60 miles were more likely to undergo CD (18.3% vs. 13.5%, $P < 0.01$).

3.3. Hospital-related demographics

Hospitals located in the western United States had the highest rate of CD (21.5%) compared to other regions of the country, $P < 0.01$. Academic programs were more likely to perform CD compared to nonacademic facilities (18.3% vs. 10.2%, $P < 0.01$). When hospital volume was analyzed, the lowest volume quartile (range 1–3 cases/year) had CD rate of 10.8% while the highest volume quartile (≥17 cases/year) had CD rate of 22.5%, $P < 0.01$.

3.4. Tumor characteristics and surgical approach

Overall, MIS surgical approach was associated with a higher rate of CD compared to open RC (13.3% vs. 11.4%, $P = 0.01$). When individual facilities were analyzed, there was no difference in CD rates between those facilities with <75% MIS cases and those ≥75% MIS, $P = 0.37$. However, after stratification by facility volume, high-volume centers performing ≥75% MIS RCs were associated with fewer CD (10.2%) compared to high-volume facilities with <75% MIS cases (19.7%), $P < 0.01$. There was no association on subgroup analysis in low, low-intermediate, and high-intermediate-volume facilities. Worse pathologic tumor stage and positive surgical margins were associated with decreased rate of CD, $P < 0.01$.

3.5. Variables associated with type of urinary diversion

Variables associated with CD on univariate analysis are shown in Table 2. On multivariable analysis (Table 2), age >80, CCI ≥ 1, Medicare insurance, urban county, pathologic T3/T4 stage, and positive surgical margins were associated with decreased rates of undergoing CD. On multivariable analysis, higher income, facility located in the West, academic program, high hospital volume, and >60 miles traveled to the hospital were associated with higher rates of CD. Prior history of neoadjuvant chemotherapy was not associated with type of UD.

3.6. Trends in urinary diversion and population

The rate of CD downtrended from 17.2% in 2004 to 2006 to 12.1% in 2010 to 2013, $P < 0.01$ (Fig. 1). Variables were trended over time and are reported in Table 3. Of note, compared to 2004 to 2006, patients diagnosed in 2010 to 2013 were older, more likely to have Medicare insurance, be operated at an academic and high-volume facility, travel ≤60 miles for care, and had more comorbidities. When comparing surgical approach, more patients underwent MIS RC in 2013 compared to 2010, $P < 0.01$. Trends in CD rates across the study period by subgroup are reported in Table 4 with most groups showing a decline in CD rates. Even among younger patients (≤65 years old) with no comorbidities (CCI = 0) the rate of CD decreased from 30.9% in 2004 to 2006 to 27.6% in 2010 to 2013 ($P < 0.01$).

4. Discussion

In our analysis of the NCDB, we report a low and declining rate of continent diversion after RC for bladder cancer in the United States from 2004 to 2013. Multiple independent variables were identified as being positively and negatively associated with undergoing CD. The overall CD rate

Table 2

Univariate and multivariable logistic regression predictors of continent diversion. Statistically significant if bold

	Univariate			Multivariable		
	OR	CI	P	OR	CI	P
Age						
≤80	Ref	–	–	Ref	–	–
>80	0.22	0.18–0.26	<0.01	0.23	0.15–0.36	<0.01
Sex						
Male	Ref	–	–	Ref	–	–
Female	0.62	0.56–0.70	<0.01	0.95	0.79–1.15	0.59
Charlson comorbidity index						
0	Ref	–	–	Ref	–	–
≥1	0.60	0.55–0.65	<0.01	0.69	0.60–0.82	<0.01
% of no high school graduates in patient's zip code of residence						
≥21%	Ref	–	–	Ref	–	–
13%–20.9%	1.04	0.93–1.17	0.47	1.11	0.86–1.45	0.42
7%–12.9%	1.11	0.99–1.25	0.06	0.87	0.66–1.15	0.33
<7%	1.40	1.25–1.57	<0.01	0.88	0.64–1.20	0.41
Insurance status						
Not insured	Ref	–	–	Ref	–	–
Private/Managed Care	1.76	1.44–2.16	<0.01	1.30	0.88–1.89	0.19
Medicaid	1.04	0.80–1.34	0.79	0.67	0.40–1.10	0.11
Medicare	0.56	0.46–0.69	<0.01	0.49	0.33–0.72	<0.01
Other	0.89	0.66–1.20	0.43	0.73	0.41–1.28	0.27
Median income						
<\$38,000	Ref	–	–	–	–	–
\$38,000–\$47,999	1.26	1.12–1.42	<0.01	1.35	1.04–1.76	0.03
\$48,000–\$62,999	1.38	1.23–1.55	<0.01	1.47	1.11–1.94	0.01
≥\$63,000	1.78	1.45–2.00	<0.01	2.00	1.47–2.73	<0.01
Facility location						
Northeast	Ref	–	–	Ref	–	–
South/southeast	0.92	0.83–1.02	0.1	0.84	0.68–1.03	0.09
Midwest	1.12	1.01–1.24	0.03	1.13	0.92–1.37	0.25
West	1.86	1.67–2.07	<0.01	1.32	1.05–1.66	0.02
Facility type						
Nonacademic facility	Ref	–	–	Ref	–	–
Academic program	1.98	1.85–2.13	<0.01	1.36	1.13–1.64	<0.01
Hospital volume						
Low (1–3 cases)	Ref	–	–	Ref	–	–
Low-intermediate (4–7 cases)	0.97	0.88–1.08	0.62	0.79	0.62–1.99	0.05
High-intermediate (8–16 cases)	1.47	1.32–1.62	<0.01	1.44	1.15–1.80	<0.01
High (17–98 cases)	2.39	2.18–2.62	<0.01	1.86	1.46–2.36	<0.01
County description						
Metropolitan	Ref	–	–	Ref	–	–
Urban	0.76	0.69–0.83	<0.01	0.65	0.53–0.81	<0.01
Rural	0.67	0.53–0.86	<0.01	0.69	0.42–1.15	0.16
Miles from patient's residence to hospital						
≤60	Ref	–	–	Ref	–	–
>60	1.43	1.32–1.55	<0.01	1.30	1.07–1.59	0.01
Surgical approach						
MIS	Ref	–	–	Ref	–	–
Open	0.84	0.74–0.95	<0.01	0.92	0.79–1.07	0.28
Pathologic stage						
<pT1	Ref	–	–	Ref	–	–
pT1	0.91	0.78–1.06	0.23	0.86	0.66–1.12	0.28
pT2	0.77	0.68–0.87	<0.01	0.88	0.71–1.09	0.25
pT3	0.61	0.53–0.69	<0.01	0.69	0.55–0.87	<0.01
pT4	0.42	0.36–0.49	<0.01	0.48	0.35–0.65	<0.01
Surgical margin						
Negative	Ref	–	–	Ref	–	–
Positive	0.54	0.47–0.61	<0.01	0.71	0.54–0.94	0.02

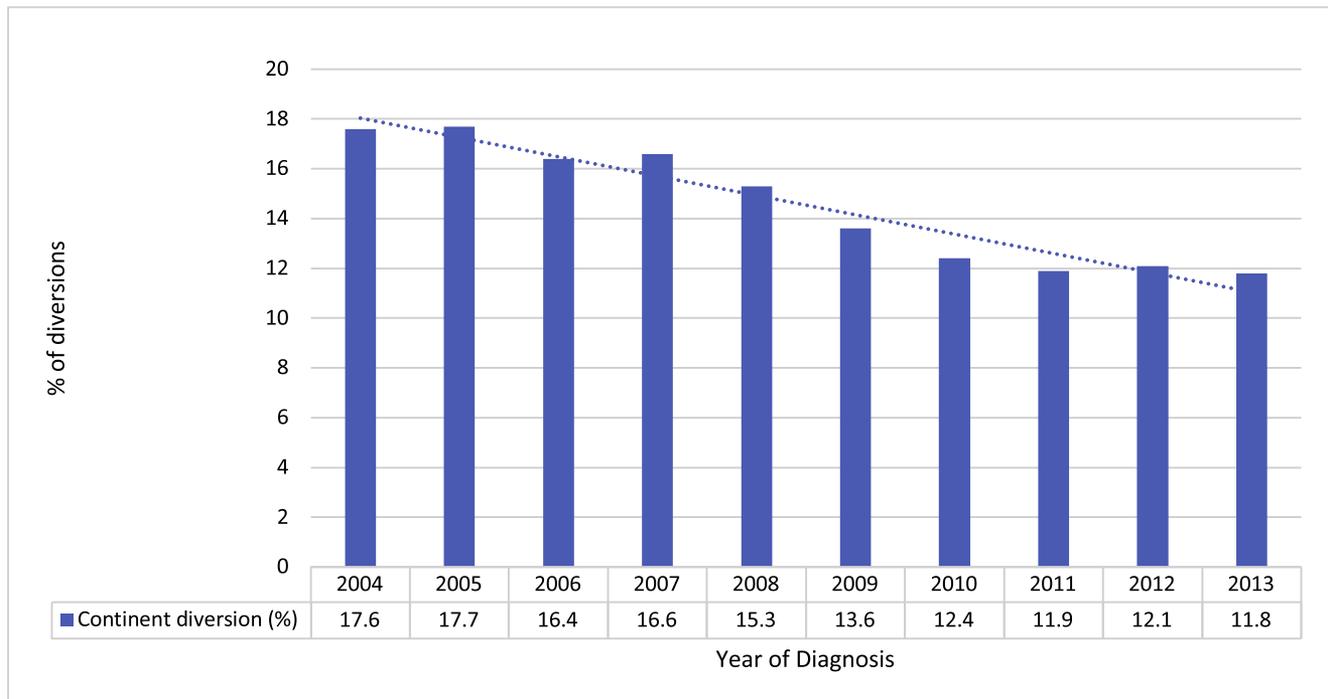


Fig. 1. Temporal trend of continent diversion after radical cystectomy from 2004 to 2013 in the United States.

of 14.5% is similar to previous national database study estimates of 8% to 19% [11–14]. While confirming prior studies that bladder cancer care is becoming increasingly centralized to high-volume centers [15,16], we identified a declining rate of CD across most subgroups suggesting that the decline in CD usage cannot be entirely explained by an aging, increasingly comorbid population. We also showed that at a facility level, high-volume centers that continue to perform a large percentage of RC using the traditional open approach have significantly higher rates of CD compared to high-volume, predominantly robotic centers.

There are important disparities that may predict the type of diversion a patient receives. Our study suggests that those on Medicare, who earn less, and do not live in a metropolitan county are more likely to receive an ID. Despite guidelines by the American Urologic Association on muscle-invasive bladder cancer, recommending clinicians discuss all forms of UD with a patient undergoing RC [17]. There may be barriers related to care access that prohibit certain populations in the United States from receiving their choice of UD. Socioeconomic status is an important driver of bladder cancer outcomes [18,19] and appears to impact type of UD as well.

Interestingly, even in academic centers and high-volume facilities, both of which were positively associated with undergoing CD, the overall rate of CD declined. To further investigate this finding, we analyzed the phenomenon of regionalization of bladder cancer treatment and changes in surgical approach. RC with UD is one of the most complex urologic procedures with significant morbidity and

mortality [2]. Improved outcomes at high-volume centers have been described [20], and our study confirms that for patients with bladder cancer who require RC, some degree of regionalization occurred during the study period. While overall, a MIS approach had a higher rate of CD compared to open RC, when we assessed high-volume hospitals performing a large proportion of RC with an open approach compared to high-volume MIS facilities, the open centers had a higher CD rate. This suggests that while national trends are indicating an increase in the utilization of the MIS approach for RC and a decline in CD rates, the relationship between the 2 surgical techniques is complex and volume-dependent [21]. Further study is needed to determine if the uptake of robotic surgery is contributing to the decline in utilization of CD.

A changing patient demographic may be contributing to the rise in ID rates. Compared to 2004 to 2006, there was an increasing mean age and patients with at least 1 comorbidity in the 2010 to 2013 period. Despite previous research showing no difference in complication rates comparing ID with orthotopic neobladder in elderly patients [22], we demonstrated that older patients and those with more comorbidities continue to be more likely to undergo ID diversion. Our study emphasizes that better education is needed so that appropriately selected patients are offered all UD options with a thorough discussion of the risks and benefits of each.

We believe our study adds to the current literature due to the extent of variables assessed, despite groups previously looking at trends in UD using the Nationwide Inpatient

Table 3
Trends in population characteristics. Statistically significant if bold

	Year of diagnosis			P	
	2004–2006	2007–2009	2010–2013		
Diversion				<0.01	
ID	82.8	84.9	87.9		
CD	17.2	15.1	12.1		
Age (mean)	67.4 (10.6)	67.8 (10.4)	68.2 (10.1)	<0.01	
Charlson comorbidity index				<0.01	
0	71.4	69.3	68.5		
≥1	28.6	30.7	31.5		
Race				0.56	
White	92.3	91.9	91.9		
Non-white	7.7	8.1	8.1		
% of no high school graduates in patient's zip code of residence				0.07	
≥21%	15.1	14.3	13.6		
13%–20.9%	25.3	26.2	26.7		
7%–12.9%	35.5	35	35		
<7%	24.1	24.5	24.7		
Median income				0.20	
<\$38,000	16.8	15.6	15.4		
\$38,000–\$47,999	25.5	26.5	26.4		
\$48,000–\$62,999	27.8	27.9	27.8		
≥\$63,000	29.9	30	30.4		
Facility type				<0.01	
Nonacademic facility	51.5	48.9	47.5		
Academic program	48.5	51.1	52.5		
Facility location				<0.01	
Northeast	19.4	19.6	19.8		
South/southeast	31.5	31	34.6		
Midwest	31.6	32	30.2		
West	17.5	17.4	15.3		
Hospital volume				<0.01	
Low	31.4	25	27.8		
Low-intermediate	27.9	24.9	25.7		
Highintermediate	21.1	22.3	21.8		
High	19.6	27.8	24.6		
County description				0.91	
Metropolitan	77.7	77.5	78		
Urban	19.7	19.8	19.3		
Rural	2.6	2.7	2.7		
Insurance status				<0.01	
Not insured	2.7	2.6	3		
Private/managed care	33.6	32.7	29		
Medicaid	3.6	3.9	4.7		
Medicare	57.3	58.8	60.9		
Other	2.8	2	2.3		
Miles from patient's residence to hospital				0.02	
≤60	78.6	78.5	80		
>60	21.4	21.5	20		
Surgical approach *(2010–2013)	2010	2011	2012	2013	<0.01
MIS	25.2	31.9	35.2	36.8	
Open	74.8	68.1	64.8	63.2	

*Surgical approach grouped by single year.

Sample [11–13] and the National Surgical Quality Improvement Program [14]. We report trends not only on the overall CD rate, but also on the population receiving CD and how the CD rate among those variables has changed, which has not been previously explored.

Furthermore, prior studies on RCs did not report the relationship between surgical approach and method of UD.

This study provides novel insight into the role that open and MIS approaches play in resulting ID and CD. With the increasing adoption of robotic RC, its influence on choice of UD should be taken into consideration.

There are several limitations to acknowledge in this study including an inherent risk of bias with a retrospective observational study. While the NCDB provides information

Table 4
Trends in continent diversion rates

	Year of diagnosis			P
	2004–2006	2007–2009	2010–2013	
Age				
≤80	18.5	16.4	13.2	<0.01
>80	5.6	4.3	2.4	<0.01
Charlson comorbidity index				
0	19	17.1	13.6	<0.01
≥1	12.8	10.6	8.8	<0.01
Health and age status				
≤65 age and no comorbidities	28.2	26.3	22.3	<0.01
>65 age or ≥1 comorbidities	12.3	10.5	8.2	<0.01
Race				
White	17.1	15.2	12.2	<0.01
Non-white	18.6	14.3	11	<0.01
% of no high school graduates in patient's zip code of residence				
≥21%	14.3	14.8	9.9	<0.01
13%–20.9%	15.9	13.5	11.5	<0.01
7%–12.9%	17.2	14.3	11.8	<0.01
<7%	19.7	18.1	14.4	<0.01
Median income				
<\$38,000	13.7	10.6	8.7	<0.01
\$38,000–\$47,999	15.6	14.2	10.8	<0.01
\$48,000–\$62,999	16.8	15.2	11.6	<0.01
≥\$63,000	20.4	18.2	15.4	<0.01
Facility type				
Nonacademic facility	12.1	10.6	8.3	<0.01
Academic program	22.3	19	15.2	<0.01
Facility location				
Northeast	13.3	13.1	12.2	0.58
South/southeast	14.6	12.2	9.8	<0.01
Midwest	16.6	14.2	12.2	<0.01
West	26.4	23	15.9	<0.01
Hospital volume				
Low	12.8	11.6	8.7	<0.01
Low-intermediate	13.8	10.8	7.9	<0.01
High-intermediate	18.6	14	13.7	<0.01
High	27.8	23.1	18.9	<0.01
County description				
Metropolitan	17.3	16	13	<0.01
Urban	16.2	12.4	8.5	<0.01
Rural	14.6	8.8	9.8	0.13
Insurance status				
Not insured	19.2	14	13.9	0.22
Private/managed care	27.6	24.4	21.2	<0.01
Medicaid	18.8	18.7	12.1	0.01
Medicare	11	9.8	7.6	<0.01
Other	15.6	13.2	12.8	0.67
Miles from patient's residence to hospital				
≤60	15.5	14.4	11.4	<0.01
>60	23.4	17.7	15	<0.01
Surgical approach *(2010–2013)	2010	2011	2012	2013
MIS	14.4	12.1	13.1	13.5
Open	11.7	11.4	11.2	10.8

on hospital volume, data regarding individual surgeon volume are not available and the impact of surgeon volume on UD rates cannot be assessed. Previously, higher surgeon volume was shown to be associated with increased use of CD in a study period that spanned from 2002 to 2010 [23].

Contraindications to CD such as renal or liver disease and ability to catheterize are not captured by the NCDB. The decision for choice of UD represents an ideal situation for shared decision making. The lack of information on patient preference needs to be considered when attempting to

explain trends in the use of CD. The NCDB does not distinguish intracorporeal vs. extracorporeal diversion after MIS surgery. Due to the technically challenging nature of performing robotic intracorporeal continent diversion, patients may be limited in their diversion choice to IC. Further studies are needed to evaluate how diversions are managed after robotic surgery as experience of the surgeon improves.

5. Conclusion

The rate of continent diversion after RC for bladder cancer in the United States has downtrended from 17.2% in 2004 to 2006 to 12.1% in 2010 to 2013. Higher income, facility geographic location in the West, academic program, high hospital volume, and traveling >60 miles for care were positively associated with receiving CD. Despite an overall national decline in CD, high-volume hospitals performing a larger proportion of open RCs had higher rates of CD compared to high-volume MIS facilities. There are multiple patient, facility, and surgical level variables associated with CD utilization of which MIS as a surgical approach appears to impact choice of diversion, indicating the potential need for increased focus on patient counseling regarding diversion options.

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