No Differences in Population-based Readmissions After Open and Robotic-assisted Radical Cystectomy: Implications for Post-discharge Care

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OBJECTIVE To inform whether readmission reduction strategies should consider surgical approach, we examined readmission differences between open and robotic-assisted radical cystectomy (RARC) using population-based data.

METHODS We identified patients who underwent cystectomy between January 2010 and September 2013 based on International Classification of Diseases-9th edition codes and administrative claims from a large, national US health insurer (Clinformatics Data Mart Database, OptumInsight, Eden Prairie, MN). We assessed post-discharge health system utilization and tested for differences in readmissions after the 2 surgical approaches.

RESULTS We identified 935 patients treated with cystectomy: open = 785 (84%) and RARC = 150 (16%). Patients undergoing RARC were slightly older, male, had more ileal conduit urinary reconstruction, and less need for intensive care. Index length of stay was shorter for RARC than for open surgery (7 days vs 8 days, $P < .001$). However, we found no differences in 30-day readmission rates (24% open vs 29% RARC, $P = .26$) or other readmission parameters, including readmission length of stay (5 days open vs 4 days RARC, $P = .32$), emergency department use (22% open vs 24% RARC, $P = .86$), reasons for readmission, or timing of first outpatient visits (11.5 days open vs 9 days RARC, $P = .41$). For both approaches, the majority of patients were readmitted within 2 weeks.

CONCLUSION The surgical approach to cystectomy does not appear to impact readmissions. Strategies to reduce the readmission burden after cystectomy do not need to consider surgical approach but should focus on timing of medical contacts. UROLOGY 104: 77–83, 2017.

Hospital readmission after major surgical procedures is common,[1] occurring in roughly 1 of 8 patients. Rates after major cancer surgery are even higher,[2-5] particularly among bladder cancer patients where 1 in 4 patients are readmitted within 30 days of hospital discharge after radical cystectomy.[4,6] This is one of the highest rates for any surgery and among the most burdensome with an average readmission length of stay (LOS) of 1 week.[6,7]

Despite standardization in surgical technique, advances in perioperative management,[8] and systems-level efforts to decrease readmissions spurred by the Centers for Medicare and Medicaid Services Hospital Readmission Reduction Program,[9] readmission rates after cystectomy have remained high over the past decade.[6] Minimally invasive

Financial Disclosure: *The authors declare that they have no relevant financial interests.*

Funding Support: *Tudor Borza received funding from National Cancer Institute T32-CA180984. Bruce L. Jacobs received funding from National Institutes of Health institutional KL2 award KL2TR001856, GEMSSTAR Award R03AG048091. Brent K. Hollenbeck received funding from National Institute on Aging R01-AG-048071. Ted A. Skolarus received funding from VA Health Services Research and Development CDA 12-171; Lavieri: National Science Foundation CMMI-1552545.*

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Submitted: October 28, 2016, accepted (with revisions): January 18, 2017

http://dx.doi.org/10.1016/j.urology.2017.01.042
0090-4295

surgery has decreased morbidity, mortality, and readmissions in other major cancer surgery, and this approach is being rapidly adopted for radical cystectomy.[10,11] To date, single-institution robotic-assisted radical cystectomy (RARC) studies have demonstrated similar oncologic outcomes, morbidity, and mortality rates.[4,12,13] However, it is unknown whether adoption of this new surgical approach has unintended consequences from novel complications (eg, positioning, out-of-field injury)[14] that should be considered in readmission reduction strategies.

For these reasons, we examined the impact of robotic assistance on readmissions following cystectomy using a large, population-based cohort. Even with a similar readmission rate, robotic assistance may be associated with differences in severity of presentation or reasons leading to readmission that need to be addressed in efforts to decrease readmissions after cystectomy.

METHODS

Data Source

We used the Clinformatics™ Data Mart Database (OptumInsight, Eden Prairie, MN) to conduct our study. This database includes administrative claims data from a large, national health insurer and contains medical (hospital and outpatient) and prescription claims for between 12 and 14 million unique members every year. All data are de-identified, but each patient is assigned a unique identifier to permit longitudinal analysis. The database has no restrictions on patient age and, therefore, our study included a more generalizable panel of patients rather than just Medicare enrollees as is common in other population-based bladder cancer studies.

Study Population

We performed a retrospective cohort study of patients treated with cystectomy between January 1, 2010 and September 30, 2013. We limited our study to patients who had continuous data available from 6 months before surgery to 30 days after surgery or death. We identified patients treated with cystectomy based on International Classification of Diseases-9th edition (ICD-9) codes for open cystectomy (57.7, 57.71, and 57.79) and RARC (open cystectomy code plus 17.4×). We identified relevant patient and surgical characteristics including age (years), gender, race/ethnicity (Caucasian, African American, Hispanic, Asian), Deyo modification of the Charlson comorbidity score (0, 1, 2, 3+), type of urinary reconstruction (ileal conduit, neobladder), use of neoadjuvant chemotherapy (yes/no), complications during index admission (infection, gastrointestinal, cardiac, pulmonary, metabolic/endocrine, hematologic, vascular, urinary, failure to thrive, wound/hematoma, other),[6] need for intensive care unit (ICU) (yes/no), LOS (days), and discharge destination (home, home with services, skilled nursing facility, other) using prior approaches.[6]

Defining Readmission Parameters After Open and RARC

We defined a readmission as any hospital admission that occurred between 1 and 30 days following hospital discharge after cystectomy consistent with the Centers for Medicare and Medicaid definition.[15] Post-discharge admission to a skilled nursing facility or similar destination was therefore not considered a readmission; however, we did include readmissions to inpatient hospital settings after initial discharge to these destinations.

For each surgical approach (ie, open and RARC), we calculated 30-day readmission rates as our primary outcome. We had several secondary outcomes, including days from hospital discharge to readmission and days to first outpatient visit for each surgical approach. We identified readmission diagnoses based on ICD-9 codes not present at the time of surgery but occurring during the index hospitalization or later as in our prior work.[6] We also identified readmission LOS, need for ICU, and emergency department visits in the administrative claims.

Statistical Analysis

First, we compared patient and surgery characteristics using a Student *t* test for continuous variables, chi-square for nominal categorical variables, and Mantel-Haenszel chi-square for ordinal categorical variables. Next, we compared readmission characteristics according to surgical approach using similar univariate statistics. To understand whether the time to readmission differed across surgical approaches and inform readmission reduction strategies, we then divided time to readmission in days into 5 categories (≤4, 5-7, 8-14, 15-21, and 22-30) for comparison across surgical approaches. Last, we used multivariable logistic regression to determine the association between surgical approaches and our readmission parameter outcomes. We used backward selection to identify significant variables. We included age, gender, race, comorbidity, urinary reconstruction type, receipt of neoadjuvant chemotherapy, discharge destination, and year of surgery; however, all variables fell out of the model, meaning the empty model had the best fit. As a sensitivity analysis we calculated an adjusted readmission rate using an a priori specified multivariable logistic regression model with age, gender, race, comorbidity, urinary reconstruction type, receipt of neoadjuvant chemotherapy, discharge destination, and year of surgery as covariates.

All statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, NC). All tests were 2-sided, and a P value <.05 was considered significant. This study was deemed exempt by the University of Michigan institutional review board.

RESULTS

We identified 935 patients treated with cystectomy during our study period. Of these, 785 (84%) were open cystectomy cases and 150 (16%) were RARC. Patients undergoing RARC were more likely to be male and receive ileal

Table 1. Cohort demographics and index admission characteristics

Characteristic	Open Cystectomy N = 785	Robotic-assisted Radical Cystectomy N = 150	*P* Value*
Mean age, years (standard error)	69 (0.37)	71 (0.81)	.06
Gender (%)			<.01
Male	80	91	
Race/ethnicity (%)			.72
White	85	86	
Black	9	13	
Hispanic	4	4	
Asian	2	1	
Comorbidity score (%)			.12
0	0	0	
1	0	0	
2	37	43	
≥3	63	57	
Urinary reconstruction (%)			.05
Ileal conduit	87	93	
Neobladder	13	7	
Neoadjuvant chemotherapy (%)	15	17	.55
Complication during index admission (%)	39	49	.16
Complication category (%)			
Gastrointestinal	10	12	.51
Pulmonary	5	5	.83
Metabolic/endocrine	5	6	.80
Hematologic	6	3	.12
Failure to thrive	5	3	.18
Wound/hematoma	5	3	.35
Vascular	2	3	.22
Urinary	2	2	.67
Cardiac	3	1	.30
Infection	3	0	.04
Other	3	1	.27
Intensive care (%)	46	38	.07
Index length of stay, median days	8	7	<.01
Discharge destination (%)			.04
Home	53	54	
Home with services	32	38	
Skilled nursing facility	11	3	
Other	4	5	

* Significant for *P* value ≤.05; *P* values for continuous variables generated from Student *t* tests. *P* values for nominal and ordinal categorical variables generated from general chi-square and Mantel-Haenszel chi-square tests, respectively.

conduit urinary reconstruction, but were otherwise similar to patients treated with open cystectomy (Table 1). Notably, there was no difference in ICU use or overall complications during the index admission. The RARC cohort did have a lower rate of infectious complications during the index admission (3% vs 0%, $P = .04$); however, all other complications occurred at similar rates. The median index admission LOS was shorter for the RARC cohort (7 vs 8 days for open, $P < .001$), and fewer patients were discharged to a skilled nursing facility.

In the unadjusted comparison of the open and RARC approaches (Table 2), we found no difference in 30-day readmission rates (24% vs 29%, $P = .26$), 90-day readmission rates (34% vs 36%, $P = .62$), readmission LOS (5 vs 4 days, $P = .32$), or emergency department use (22% vs 24%, $P = .86$). Similarly, there was no difference in the adjusted readmission rate (24% vs 30%, $P = .18$).

As illustrated in Figure 1, the most common reasons for readmission were infection, followed by urinary, gastrointestinal, and metabolic/endocrine complications. Almost all readmitted patients (96% for open and 98% for RARC) had more than 1 readmission diagnosis whereas 18% of open and 16% of RARC readmitted patients had 5 or more new diagnoses. Overall, we identified no significant differences in the reasons for readmission between the open and the RARC groups.

In both groups, the majority of readmissions occurred within the first 2 weeks following discharge (Fig. 2). Similarly, median time to first emergency department visit was 9.5 days for the open cohort and 12 days for the RARC cohort ($P = .41$) and median time to first outpatient visit was 11.5 days for open and 9 days for RARC ($P = .41$).

DISCUSSION

This contemporary, population-based study found that approximately 1 in 4 patients were readmitted in 30 days after radical cystectomy regardless of surgical approach. We found

Table 2. Readmission characteristics for open and robotic-assisted radical cystectomy*

Characteristic	Open Cystectomy (N = 785)	Robotic-assisted Radical Cystectomy (N = 150)	*P* Value*
30-Day readmissions (%)	24	29	.26
Time to readmission (%)			.92
≤4 d	20	16	
5-7 d	18	23	
8-14 d	29	26	
15-21 d	24	26	
22-30 d	19	9	
Readmission length of stay, median days	5	4	.32
Readmission diagnosis (%)			
Infection	59	65	.43
Gastrointestinal	42	49	.41
Cardiac	20	14	.37
Pulmonary	24	21	.71
Metabolic/endocrine	34	46	.12
Hematologic	15	9	.32
Vascular	6	2	.31
Urinary	51	67	.06
Failure to thrive	24	33	.25
Wound/hematoma	20	16	.54
Other	61	49	.16
Emergency department visits (%)	22	24	.86
Time to emergency department visit (%)			.41
≤4 d	26	19	
5-7 d	15	17	
8-14 d	28	28	
15-21 d	16	22	
22-30 d	15	14	

* Significant for *P* value ≤.05; *P* values for continuous variables generated from Student *t* tests. *P* values for nominal and ordinal categorical variables generated from general chi-square and Mantel-Haenszel chi-square tests, respectively.

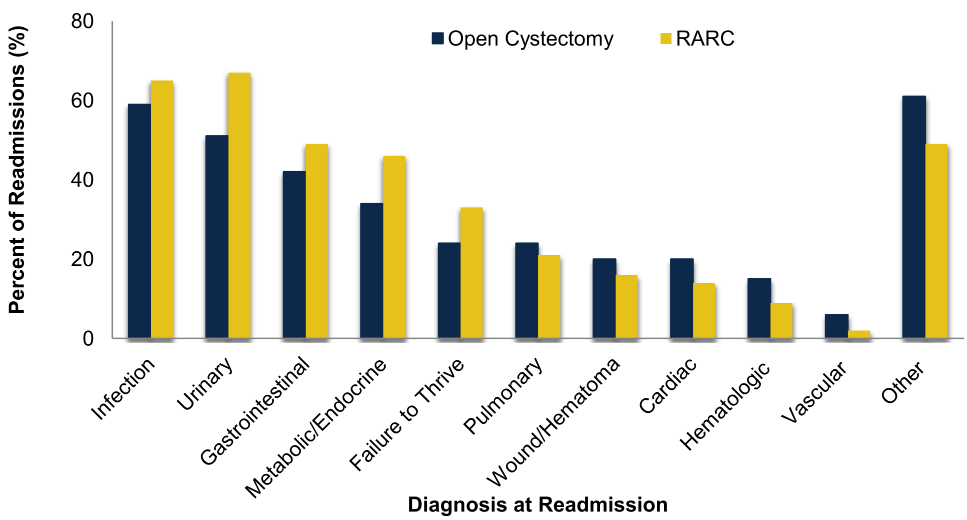

Figure 1. Comparison of reasons for hospital readmission for open and robotic-assisted radical cystectomy in a population-based cohort. All comparisons are nonsignificant (*P* > .05). Ninety-six percent of open and 98% of robotic-assisted radical cystectomy patients had multiple new diagnoses at readmission. There were no significant differences between the open or robotic approaches. (Color version available online.)

no associations between the open or robotic surgical approaches to radical cystectomy and the subsequent readmission rate or other readmission parameters. Notably, two-thirds of all readmissions occurred within 2 weeks of discharge in both groups. Our readmission rates are comparable to those reported from other contemporary open and robotic series (18%-28%)[4,12,16-19]; however, no studies to date have examined more detailed attributes of the readmission that may inform readmission reduction strategies. Further, our analysis represents the most contemporary

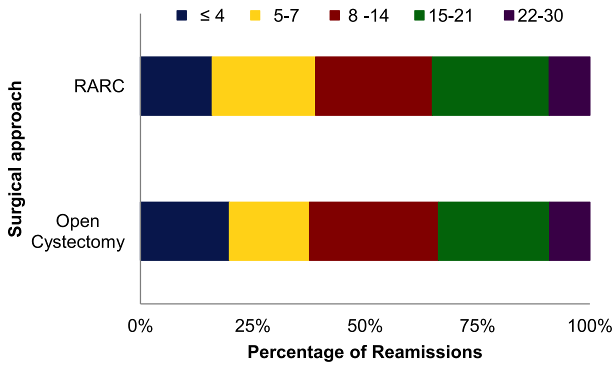

Figure 2. Days to hospital readmission after open and robotic-assisted radical cystectomy. There were no differences between the open and robotic approaches. (Color version available online.)

analysis of population-level data during the adoption phase of robotic cystectomy across the United States. Given that the broader adoption of the robotic approach did not occur until around 2009,[12,18] this study captures surgery being performed outside early adopting centers of excellence and thus more likely reflects real-world practice. As the surgical approach to cystectomy does not appear to impact various aspects of readmission, strategies to reduce the readmission burden after cystectomy should not primarily focus on the surgical approach but rather on the critical 1-2 weeks after discharge.

The current study significantly expands our understanding of readmissions following cystectomy by exploring the effect of surgical approach not only on overall readmission rates at the population level, but also on readmission parameters that better characterize the readmission itself. Data comparing readmission rates between open and robotic approaches are currently limited with 2 prior studies also reporting a lack of difference in overall readmission rate based on surgical approach.[12,18] We chose to more deeply explore the readmission episode because robotic surgery has the potential to result in novel complications compared with the open approach (eg, due to positioning, out-of-field injury).[14] In addition, even though both approaches could lead to the same complication, the severity of the complication, and thus the burden of the readmission, could vary substantially. Nonetheless, we found no differences in the reasons for the readmission between the 2 surgical approaches; that is, patients undergoing RARC were not being readmitted because of a novel or distinct set of complications. This finding is supported by a recent randomized trial of open cystectomy vs RARC that found no difference in the number, severity, or type of postoperative complications between the 2 arms.[13] Although the initial hospitalization median LOS was 1 day shorter for the RARC cohort, it is unlikely that this difference would impact the reasons for readmission in any clinically relevant fashion. Further, the median LOS for the readmission was not significantly different, suggesting the severity of the complications and readmissions were likely comparable. We also noted an overall low rate of neobladder use, which was significantly lower in the robotic group. Although this difference was not a significant predictor of readmission in our multivariable model, differences in the type of urinary reconstruction should continue to be explored as they may be different in cohorts with higher neobladder use.

Consistent with prior work,[6,13,16,20] we found infection, urinary, gastrointestinal, metabolic/endocrine complications, and failure to thrive to be the most common reasons for readmission (Fig. 1). Despite the lack of a difference, we highlight the fact that, even in contemporary settings, readmissions following cystectomy are high intensity stays as most readmitted patients had multiple new diagnoses at the time of readmission, and the readmission LOS was 5 days following open cystectomy and 4 days following RARC.[17] Emergency department use was substantial in both cohorts, with just under one-quarter of patients seen within 30 days of discharge, but did not differ significantly by approach. Taken together, our findings demonstrate that the substantial burden of readmissions following cystectomy on patients, providers, and hospital systems is not altered by whether someone has an open or robotic-assisted surgery. Therefore, efforts to reduce readmissions after cystectomy should likely focus on early communication after discharge,[21] prompt detection of clinical decompensation, and providing support during the first week after discharge,[22] rather than on the surgical approach itself.

Our findings should be considered in the context of several limitations. First, although the Clinformatics Data Mart Database allows for a granular inspection of multiple inpatient and outpatient outcomes, mortality data are absent in an effort to protect patient confidentiality. Although it is possible that differences in 30-day mortality between approaches could change our readmission findings, previous studies have found similar, low mortality rates for the 2 approaches.[13,18,23] Second, our database lacks clinically relevant data such as tumor grade and stage, extent of lymphadenectomy, approach to urinary reconstruction (open or intracorporeal) for RARC, and pathology results. However, we did adjust for neoadjuvant chemotherapy and diversion type which reflect, at least to some degree, the burden of disease. For example, neoadjuvant chemotherapy use is more common for patients with more advanced disease.[24] We also noted a difference in the proportion of patients discharged to a skilled nursing facility between the open and the robotic groups. This could arise from unmeasured differences in comorbidity, as we found no difference in comorbidity score, differences in practice patterns, or patient preference, and may lead to differences in readmission parameters. However, given that only 14 patients (11 in open and 3 in robotic group) were discharged to a skilled nursing facility, this is unlikely to affect our findings.

By using a large, national insurance database without age restrictions, our findings also mitigate some of the generalizability concerns that arise from current single and multi-institutional series.[4,16] These series tend to reflect early adopting centers of excellence and potentially fail to capture readmissions occurring outside their health system. Similar generalizability concerns arise with use of the Surveillance, Epidemiology, and End Results Program-Medicare data,[6,12,25] which are limited to patients 65 years of age and older, where comorbidity status and baseline function could differ compared with younger patients.

Last, we have no information on perioperative care pathways for our cohort. Despite a limited understanding on how these pathways may impact readmissions, they have been shown to decrease the index LOS[26] and therefore could potentially alter the reasons for readmission. It is also possible that early adopters of RARC may also be early adopters of standardized perioperative care pathways, which could alter readmission parameters. Going forward, re-evaluating the effect of RARC on readmissions in the setting of greater adoption of perioperative and post-discharge care pathways may be warranted. In addition, continued investigation into the types and timing of post-discharge follow-up care is needed to minimize preventable readmissions and readmission intensity for those in need of inpatient care.[20]

These limitations notwithstanding, our findings have significant implications for patients, physicians, and policy makers. We have shown that the robotic approach has neither a beneficial nor deleterious effect on readmission rates or readmission parameters after radical cystectomy. As such, the higher cost of RARC[13,18] would not seem to be offset by savings from the readmission episode. Additionally, the robotic approach appears to have a comparable set of complications to the open approach. More importantly, we found that, despite the increased attention paid to readmission reduction at a policy level as a result of the Centers for Medicare and Medicaid Services Hospital Readmission Reduction Program[15] and introduction of standardized perioperative care pathways,[8,26] the rates of readmission following cystectomy have not improved in a clinically meaningful way. This may be due, in part, to the inherent morbidity of the procedure and the baseline comorbid state of patients that leads to some degree of nonmodifiable reasons for readmission,[19] but is also likely related to suboptimal post-discharge follow-up. In an administrative database analysis, James et al showed that 26% of cystectomy readmissions were considered modifiable,[19] and Krishnan et al demonstrated that detection of at-risk patients could be improved with early clinician contact.[22] It is likely that even in the cases of some nonmodifiable readmissions, earlier identification of at-risk patients would allow for prompt intervention and a reduction in the intensity of the overall readmission episode,[17] as was evident by the multiple new diagnoses present in our cohort at the time of readmission.

CONCLUSION

This contemporary, population-based study found that approximately 1 in 4 patients were readmitted within 30 days after radical cystectomy regardless of surgical approach. We found no differences between the open or robotic surgical approaches to radical cystectomy and the subsequent readmission rate or other readmission parameters. Because the surgical approach to cystectomy does not appear to impact various aspects of readmission, strategies to reduce the readmission burden after cystectomy must not only focus on surgical technique (rather than approach) but also include a careful examination of the preoperative patient readiness for surgery, the preventable complications during the index admission, and early detection and intervention on postoperative risk factors that permit complications to develop, progress, and ultimately require admission.

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EDITORIAL COMMENT

A decade after the initial clinical reports on robotic radical cystectomy, we now have a preponderance of data to assess potential benefits and harms of this minimally invasive procedure. Multiple studies—ranging from case series to randomized trials to meta-analyses—have demonstrated the potential for the robotic approach to (1) reduce blood loss and transfusion requirements, (2) decrease postoperative pain, (3) reduce 30- and 90-day complications (especially wound complications), and (4) decrease length of stay (LOS) (demonstrated in multiple series including the present study by Borza et al).[1-3] All of these benefits are occurring without compromising the oncologic integrity of the operation.

The last point, regarding reduction in LOS, has a variety of clinical and economic benefits for patient and for our health-care systems. However, such benefits should only be embraced if there is not an unintended downstream harm, including increased readmissions. In other words, are we getting the patients out of the hospital faster (perhaps "too fast") only to have them bounce back with an emergency department visit or hospital readmission? This remains a highly relevant question. The "negative finding" reported by Borza et al demonstrates that reduction in LOS associated with the robotic surgical approach does *not* impact (neither beneficial nor deleterious) readmission rates, readmission parameters, or emergency department visits after radical cystectomy.[3] Furthermore, the authors found no differences in the reasons for readmission between the 2 surgical approaches; that is, patients undergoing robotic cystectomy were not being readmitted because of a novel or distinct set of complications.[3]

These findings are reassuring, but the burden of hospital readmissions for our cystectomy patients remains. Hospital readmission has undesirable effects on several levels. First, readmissions pose an unwelcome morbidity and clinical hardship to patients and their family members. Moreover, studies have demonstrated that patients readmitted after radical cystectomy have worse survival vs those who were not readmitted. This finding is not only true for cystectomy but for other major surgical oncologic cases, including esophagectomy, lobectomy, and pancreatectomy.[4]

In addition to the impact on patient morbidity and mortality, readmissions now have important system-level ramifications on quality assessments with resultant financial consequences for hospitals. The Centers for Medicare and Medicaid Services has created an initiative (Hospital Readmission Reduction Program) to evaluate the burden of readmissions with accompanying financial penalties (withholdings) for hospitals that exceed risk-adjusted norms. In fact, in 2016, it is estimated that Centers for Medicare and Medicaid Services withheld approximately $500 million from hospitals for high readmission rates. This policy level intervention has drawn the attention of health-care systems to better address the burden of readmissions after index hospitalizations for both medical and surgical interventions.

So, how do we avoid readmissions in our cystectomy patients? This is a daunting question with likely no singular or easy solution. However, it does represent an opportunity for us to make high impact assessments and adaptations—likely multifactorial—to improve our patients' outcomes. Adaptations may include patient navigators, more frequent follow-ups, virtual visits (eg, telehealth or structured phone calls), health-care wearables or remote at-home monitoring, and improved care coordination with local primary care providers, just to name a few. This challenge represents an exciting opportunity to look beyond product innovation toward process innovation focused on the delivery of health care.

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UROLOGY 104: 83, 2017.