



# Prostate cancer navigation: initial experience and association with time to care

Emily C. Serrell<sup>1</sup> · Moritz Hansen<sup>1,2,3</sup> · Greg Mills<sup>2,3</sup> · Andrew Perry<sup>4</sup> · Tracy Robbins<sup>4</sup> · Melanie Feinberg<sup>4</sup> · Scot C. Remick<sup>4</sup> · Lisa Beaulé<sup>1,2</sup> · Matt Hayn<sup>1,2</sup> · Tom Kinkead<sup>1,2</sup> · Paul K. J. Han<sup>1,3</sup> · Jesse D. Sammon<sup>1,2,3</sup>

Received: 11 May 2018 / Accepted: 14 August 2018 / Published online: 27 August 2018  
© Springer-Verlag GmbH Germany, part of Springer Nature 2018

## Abstract

**Objective** To evaluate factors associated with use of patient navigation in a prostate cancer population and identify whether navigation is associated with prolonged time to care. Cancer patient navigation has been shown to improve access to cancer screening, diagnosis, and treatment, but little is known about patient navigation in prostate cancer care.

**Methods** All men diagnosed with localized prostate cancer between 2009 and 2015 were abstracted from the Maine-Health multi-specialty tumor registry. Regression analyses controlling for patient-, disease-, and system-level factors evaluated characteristics associated with navigation utilization. The association between navigation utilization, barriers to care, and longer time to treatment was assessed with Cox proportional hazards regression.

**Results** Of the patient population ( $n = 1587$ ), 85% of men were navigated. Navigation use was associated with earlier year of diagnosis, treatment by a high-volume urologist, and lower risk disease ( $p < 0.05$ ). Treatment delay was associated with low-risk disease (vs: intermediate OR 0.62, 95% CI 0.46–0.85 and high OR 0.16, 95% CI 0.1–0.25) and receipt of navigation services (OR 1.65, 95% CI 1.12–2.45) but not distance to care, insurance, or treatment choice.

**Conclusions** We observed that patients with low-risk prostate cancer were more likely to utilize navigation, but traditional barriers to care were not associated with utilization. Navigation was associated with longer time to treatment, which likely reflects clinically appropriate delays associated with greater shared decision making. Time to treatment may not be the ideal metric for evaluating navigation in prostate cancer; shared decision making, patient satisfaction, and psychosocial outcomes may be more appropriate.

**Keywords** Prostate cancer · Quality improvement · Patient navigation · Shared decision making

## Introduction

Prostate cancer is the most common solid-organ malignancy in American men [1]. Although mortality has decreased over the past two decades, this progress is not shared equally among all populations. Patient characteristics like older age, lower income and education, ethnicity/race, and farther distance from care have been associated with worse outcomes [2, 3]. Complicating this issue further is underlying uncertainty about the ratio of benefit to harm between active

treatments or surveillance of localized disease [4, 5]. In the face of such uncertainty, shared decision making has been recommended as an approach to help patients make value-concordant treatment decisions [6], but it remains unclear how to best operationalize shared decision making [7–9].

A promising intervention to address socioeconomic disparities and promote value-based treatment may be patient navigation. First described in 1995 as an approach to improve breast cancer screening and follow-up care among low-income women [10], navigation has more recently become a standard of care at many institutions [11] and has been associated with completion of recommended cancer screening [12, 13], more timely cancer diagnosis or care [13–17], and reduction in healthcare disparities [10, 17–19].

Yet evidence examining the role of navigation in prostate cancer management remains scarce. Early studies in the 1990s demonstrated increased prostate cancer

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s00345-018-2452-y>) contains supplementary material, which is available to authorized users.

✉ Jesse D. Sammon  
jsammon79@gmail.com; jsammon@mmc.org

Extended author information available on the last page of the article

screening in African American men [20, 21], but subsequent reports have examined mixed cancer populations; prostate cancer presents different diagnostic and treatment considerations than breast, cervical, and colorectal cancers [13, 19]. The largest such study was the nine-site Patient Navigation Research Program (PNRP), a joint initiative between the National Cancer Institute and American Cancer Society (ACS) to evaluate the effect of navigation on cancer care [13, 14, 22]. The study identified faster resolution of abnormal screening tests (OR 1.51, 95% CI 1.23–1.84) and treatment initiation (OR 1.43, 95% CI 1.10–1.86) [14]. However, prostate cancer represented only 12% of the sample ( $n=255$ ) and subgroup analysis did not demonstrate improved time to care for prostate cancer [14].

Based on promising early reports on patient navigation in cancer care, in 2008 MaineHealth—a large, multi-institutional healthcare network—implemented one of the nation’s first prostate cancer-specific patient navigator programs. Specific goals of the program were to: (1) identify healthcare barriers and connect patients to support services; (2) coordinate multidisciplinary care; (3) educate patients; (4) address emotional and spiritual concerns; (5) understand patient preferences to facilitate shared decision making; and (6) optimize evidence based care (Fig. 1).

In this study, we evaluate the implementation of a prostate cancer navigation program and factors associated with its use. Similar to other cancer navigation programs, we evaluated the association between navigation and time to treatment. We hypothesized that navigation would be associated

with shorter time between diagnosis and treatment initiation, particularly in men with traditional barriers to care.

## Materials and methods

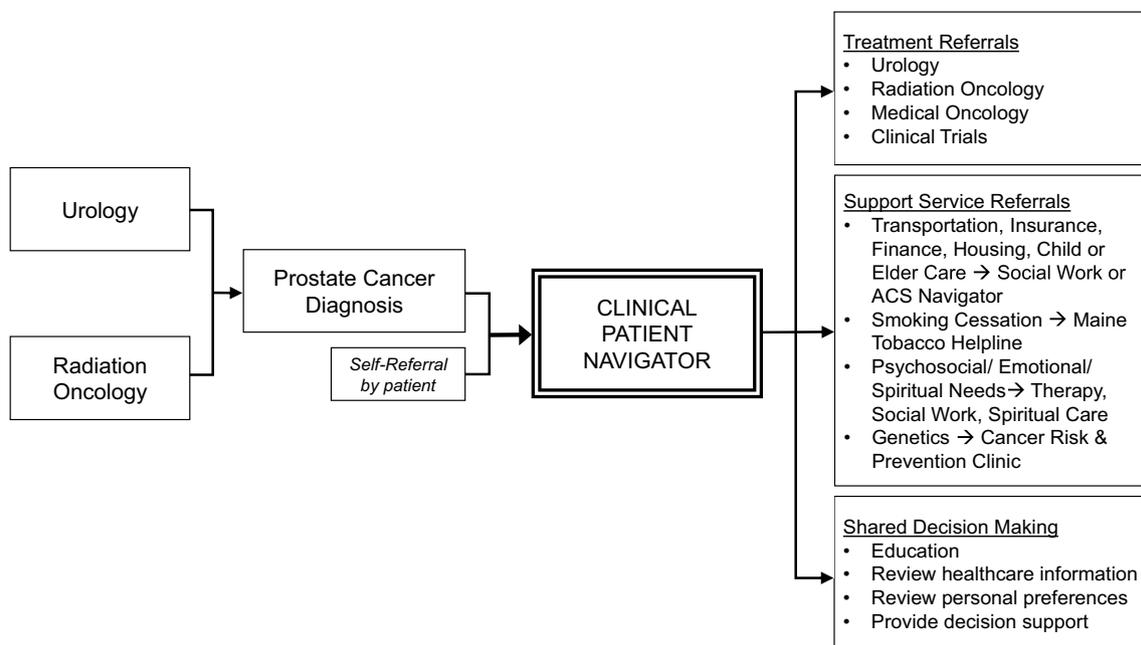
### Setting

MaineHealth is a non-profit, integrated, rural health system comprised 12 hospitals and healthcare networks including the Maine Medical Center Cancer Institute (MMCCI). There are approximately 250 patients with newly diagnosed prostate cancer per year, representing approximately a third of all diagnoses in the state of Maine.

### Patient navigation process

A definition for patient navigation was adopted from the National Cancer Institute’s PNRP as “support and guidance offered to persons with abnormal cancer screening or a new cancer diagnosis in accessing the cancer care system, overcoming barriers, and facilitating timely, quality care provided in a culturally sensitive manner” [22]. All prostate cancer navigators were registered nurses with oncology certification who participated in ACS and National Comprehensive Cancer Network (NCCN) seminars on prostate cancer knowledge, communication, and shared decision making.

Following initial consultation (Fig. 1), patients were enrolled by their initial point of contact (e.g., urologist or radiation oncologist) unless they declined navigation. Patient



**Fig. 1** Prostate Cancer Navigation-Workflow and Services Provided

navigation was defined as at least one phone conversation between the patient and the navigator. The navigator–patient relationship was initiated with a 30–45 min telephone call that included a description of the patient navigation program as an independent treatment decision-making support intervention, collection of demographic information, and discussion of the patient’s understanding of his diagnosis and treatment options. Disease-specific discussions utilized NCCN guidelines, referral to support groups, and navigation through specific patient-centered decision aids including The Memorial Sloan-Kettering Institute’s Pre-treatment Prediction Tool [23], the Johns Hopkins University Partin Tables [24] and the US Agency for Healthcare Research and Quality Clinically Localized Prostate Cancer Decision Aid [25]. In addition, the navigator encouraged and facilitated multidisciplinary care, provided social and emotional support, screened for barriers to healthcare access, and made referrals to social work, nutrition, pelvic floor rehabilitation, clinical trials and genetics.

### Population and covariates

Patients with prostate cancer diagnosed between 2009 and 2015 were selected as the study cohort; cases were excluded for unknown stage/grade, diagnosis at the time of cystoprostatectomy, positive lymph nodes, or metastasis.

The primary exposure variable was patient navigation. The primary outcome was time from diagnosis to treatment initiation. Diagnosis date was defined as the date of positive results from a transrectal ultrasound-guided biopsy. Treatment initiation was defined as the first date of receipt of therapy or as the date of decision to initiate active surveillance, as verbalized by the patient to the navigator, urologist, radiation oncologist or medical oncologist. Time to treatment was categorized as quartiles based on equally proportioned days to treatment.

Patient variables examined included the following: year of diagnosis; age; race; tobacco use; marital status; insurance status; and cancer management by the highest-volume urologist decile (52% of all diagnoses). Distance from care was calculated as the minimum travel time from a patient’s residence zip code centroid to the treatment facility’s street address utilizing Google Maps Distance Matrix API [26]. Using published guidance by Lin et al. [27], distance was categorized as < 12.5, 12.5–49.9, 50–249.9, and > 250 miles. Income was estimated utilizing patient’s zip code-based median household income, derived from the 2010 US Census [28], and categorized as quartiles.

Disease characteristics included prostate-specific antigen (PSA), Gleason score, and clinical TNM staging. Patients were categorized by NCCN risk-category (Version 2.2017): Very low/Low grade (< T2a, Gleason ≤ 6, PSA < 10 ng/mL; Intermediate grade (T2b–T2c, Gleason 7, PSA 10–20 ng/

mL); High grade (T3a, Gleason 8–10, or PSA > 20 ng/mL); Very high grade (T3b–T4, primary Gleason pattern 5 or > 4 cores Gleason 8–10).

### Data source and statistical analysis

Patient data were prospectively collected in the MaineHealth cancer registry database in accordance with Commission on Cancer data standards by trained data managers. In 2016, de-identified data from 2009 to 2015 were extracted by the Information Services Coordinator (AP). For the years 2014 and 2015, co-investigators (GM, ECS) abstracted data from navigated patient’s comprehensive electronic medical record to identify pre-navigation treatment uncertainty, barriers, and referrals made; these data are available in the Appendix.

Descriptive statistics were calculated on patient and disease characteristics and stratified according to receipt of navigation. The median and interquartile range (IQR) were generated for continuous variables, and frequencies and percentages were generated for categorical variables. The Mann–Whitney and Fisher’s exact test were used to assess the statistical significance of differences in medians and proportions, respectively.

All analyses were planned a priori. Multivariable logistic regression models controlled for patient, disease, and system-level factors were performed to evaluate factors associated with navigation. To evaluate factors associated with time to treatment, a subgroup of patients in the top quartile of time from treatment was identified. Unadjusted time-to-event Kaplan–Meier curves were calculated. Curves were compared using the log-rank test. Multivariable logistic regression analyses were performed. Interaction terms were evaluated to determine the relationships between navigation, time to treatment and: NCCN cancer risk, travel distance, income, insurance, or treatment type. Cox proportional hazards modeling was used to assess the independent effect of patient navigation on time to treatment.

All statistical analyses were performed in 2017 using the Statistical Package for the Social Sciences (SPSS Inc, Armonk, New York, IBM Corp), with a two-sided significance level set at  $p < 0.05$ . An institutional review board waiver was obtained prior to conducting this study, in accordance with institutional guidelines when utilizing de-identified administrative data.

## Results

### Navigation utilization

Between 2009 and 2015, a total of 1784 patients were diagnosed or treated for localized prostate cancer; 197 (11%) had incomplete data, leaving a sample size of 1587 for analysis.

Demographic characteristics are reported in Appendix Table e1. Median age was 64 (IQR 59–69), and patients were predominantly white (98%). A total of 1349 (85%) men were navigated.

After adjustment, patients with high-risk disease were less likely than those with low-risk disease to be navigated [Odds Ratio (OR) 0.64, 95% Confidence Interval (CI) 0.42–0.98]. Patients treated by a high-volume surgeon were more likely to be navigated (OR 7.33, 95% CI 4.96–10.83). Younger patient age was non-significantly associated with increased navigation (OR 0.97, 95% CI 0.95–1.0). Significant variables associated with navigation are listed in Table 1.

### Time to treatment

Median duration from diagnosis to treatment decision was 77 days (IQR: 49–110). In the top quartile ( $n=410$ ), median

**Table 1** Characteristics significantly associated with navigation, 2009–2015

	OR (95% CI)	<i>p</i> value
Age at diagnosis	0.97 (0.95–1)	0.053
Year of diagnosis		
2009	Ref	–
2010	1.67 (0.92–3.03)	0.09
2011	1.48 (0.84–2.6)	0.17
2012	<b>2.13 (1.12–4.03)</b>	<b>0.02</b>
2013	<b>2.21 (1.15–4.27)</b>	<b>0.02</b>
2014	1.14 (0.63–2.06)	0.66
2015	0.96 (0.55–1.68)	0.88
NCCN risk group		
Low	Ref	–
Intermediate	0.69 (0.46–1.03)	0.07
High/very high	<b>0.62 (0.41–0.96)</b>	<b>0.03</b>
Marital status		
Never	Ref	–
Married	1.46 (0.82–2.59)	0.20
Separated/divorced/widowed	1.23 (0.62–2.43)	0.55
Other/unknown	<b>2.61 (1.12–6.1)</b>	<b>0.03</b>
Urologist surgeon volume		
Low	Ref	–
High <sup>a</sup>	<b>7.33 (4.96–10.83)</b>	<b>&lt; 0.001</b>

Data from multivariable logistic regression analysis adjusting for factors above as well as nonsignificant factors including: insurance status, race/ethnicity, tobacco use, distance to treatment, zip code associated income. Items in bold are significant with  $p < 0.05$

CI Confidence Interval, NCCN National Comprehensive Cancer Network, NOS Not otherwise specified, OR Odds Ratio, Ref Referent value

<sup>a</sup>High volume urologist: the top decile of urologists (by treatment volume) accounting for 55% of all diagnosed prostate cancer

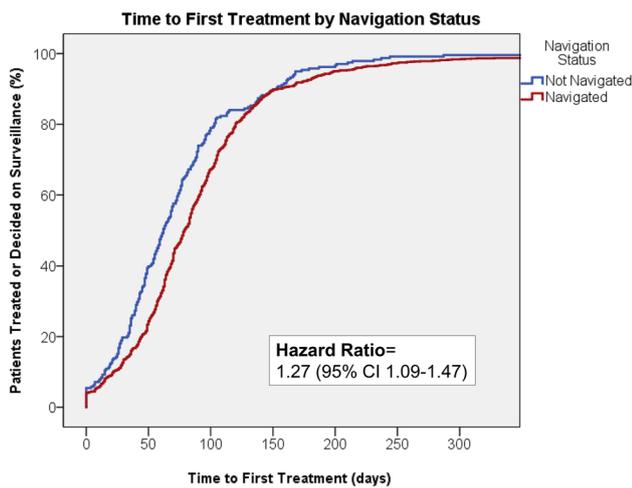
time to treatment was 140 days (IQR: 120–183). Factors associated with longer time to treatment are listed in Table 2. Navigation was significantly associated with longer time to treatment (OR 1.65, 95% CI 1.12–2.45), along with diagnosis earlier in the study, a history of no marriage, and living in a low-income zip code. Hazard ratio for time to treatment was 1.27 (95% CI 1.09–1.47; Fig. 2) for navigated versus not navigated patients. Patients with higher risk disease were treated faster (referent low-risk versus: intermediate

**Table 2** Multivariable logistic regression analysis: factors associated with longer time to treatment (quartile,  $n=410$ ), 2009–2015

	OR (95% CI)	<i>p</i> value
Received patient navigation		
Not navigated	Ref	–
Navigated	<b>1.65 (1.12–2.45)</b>	<b>0.01</b>
NCCN risk group		
Low	Ref	–
Intermediate	<b>0.62 (0.46–0.85)</b>	<b>0.002</b>
High/very high	<b>0.16 (0.1–0.25)</b>	<b>&lt; 0.001</b>
Age at diagnosis	0.98 (0.96–1)	0.08
Year of diagnosis		
2009	Ref	–
2010	1.28 (0.82–2)	0.28
2011	1.13 (0.71–1.77)	0.61
2012	0.89 (0.55–1.43)	0.62
2013	<b>1.77 (1.11–2.83)</b>	<b>0.02</b>
2014	0.84 (0.51–1.38)	0.49
2015	0.93 (0.57–1.5)	0.75
Treatment group		
ADT	Ref	–
Radical prostatectomy	1.31 (0.25–6.96)	0.75
Radiotherapy	1.59 (0.3–8.42)	0.58
Active surveillance	0.33 (0.06–1.82)	0.20
Other/unknown	0.74 (0.12–4.65)	0.75
Marital status		
Never	Ref	–
Married	<b>0.58 (0.36–0.93)</b>	<b>0.02</b>
Separated/divorced/widowed	0.68 (0.38–1.22)	0.19
Other/unknown	<b>0.46 (0.24–0.89)</b>	<b>0.02</b>
Zip code income (\$)		
< 35,709	Ref	–
35,709–40,773	<b>0.58 (0.4–0.83)</b>	<b>&lt; 0.001</b>
40,774–47,940	0.78 (0.54–1.12)	0.17
> 47,940	<b>0.63 (0.43–0.93)</b>	<b>0.02</b>

Multivariable logistic regression analysis of the subgroup of the top quartile of patients in time from diagnosis to treatment controlling for above characteristics, as well as the following non-significant factors: race/ethnicity, tobacco use, insurance status, urologist volume, and distance to care. Items in bold are significant with  $p < 0.05$

ADT Androgen deprivation therapy; CI Confidence interval, OR Odds ratio, Ref Referent value



**Fig. 2** Kaplan-Meier plot examining time to treatment in the Navigated and Not Navigated populations. Full population ( $n = 1,587$ ) median time to treatment was 77 days (IQR: 49–110). Navigation was associated with a longer time to treatment

OR 0.62, 95% CI 0.46–0.85; high/very high OR 0.16, 95% CI 0.1–0.25). No time to treatment relationship was demonstrated for treatment type, insurance status, distance to treatment, race/ethnicity, surgeon volume, or tobacco use.

Interaction terms demonstrated that the relationship between navigation and time to care was not moderated by cancer risk, travel distance, income, insurance, or treatment type.

## Discussion

In this study, we evaluated the implementation of our oncology nurse navigation program. Based on cancer navigation programs that found improved time to treatment [13–17], we assessed time from diagnosis to treatment as an outcome in men with localized prostate cancer. Contrary to our original hypothesis, we observed that navigation was associated with longer rather than shorter time to treatment (OR 1.65, 95% CI 1.12–2.45). In interaction analysis, navigation-associated longer times to treatment were not associated with treatment type or potential barriers to care.

Few studies have evaluated navigation in a prostate cancer population. To our knowledge, one of the only prostate-specific groups is a Chicago Veterans Affairs program employing a social worker and lay health worker to manage healthcare barriers in a predominantly African American cohort. They found no significant relationship between navigation and time from abnormal screening to diagnosis or from diagnosis to treatment [29]. Our findings may likewise reflect that prostate cancer is fundamentally different from other cancers—with controversial screening and ambiguous

treatment choices—and that improving timely treatment may not be the best metric of success for navigation programs. Furthermore, treatment delays for patients with low and intermediate risk prostate cancer are unlikely to be clinically relevant [30].

Indeed, we found that lower risk disease was also associated with longer time to treatment ( $p < 0.001$ ). In this population, longer time to treatment may be beneficial if it results from multidisciplinary, patient-centered care and shared decision making. Having enough time to make a decision is valued by patients and is positively associated with perception of patient-centered decision making [31]. Thus, although providing education and emotional support may increase time to treatment, patients may value being more informed and involved in decision making. Shared decision making may be a useful outcome by which to assess the effectiveness of patient navigation, and is associated with increased patient and provider satisfaction [6]. However, it remains difficult to implement [7–9]. Independent patient navigators may be uniquely suited to ensure shared decision making among the over half of patients who are undecided at the time of navigation initiation. For such patients, navigators can facilitate referrals to multiple specialty care providers, thereby promoting informed, preference-sensitive decisions.

Of the total population of men with localized prostate cancer, 15% of patients refused services could not be contacted and/or did not receive a referral. Encouragingly, sociodemographic characteristics associated with barriers to care—distance from treatment facility, median household income, insurance status, and race/ethnicity—were not associated with navigation. Instead, factors negatively associated with navigation included increased age (OR 0.97, 95% CI 0.95–1.0) and high-risk disease (OR 0.62, 95% CI 0.96). It is uncertain whether this may reflect patient preferences, physician bias, or care needs. For example, older patients are more likely to have high-risk prostate cancer [1], for which there are fewer treatment options. Therefore, physicians may not identify the benefit of navigation for decision-making support and patients may not have as much difficulty making treatment decisions. However, because both age and disease severity have been independently associated with reduced shared decision making [31] and older patients are less likely to receive information about non-clinical services [32]; this may be a population that particularly benefits from navigation. Finally, treatment by a high-volume urologist was highly associated with navigation (OR 7.33, 95% CI 4.96–10.83). There is extensive literature about the positive correlation between high-volume and superior surgical and survival outcomes [33]. Higher utilization of navigation may reflect the fact that high-volume providers—because of exposure to more patient outcomes and complications—better understand the implicit uncertainty about a “right”

treatment for patients and depend on the navigator to help identify the most patient-centered treatment.

Limitations of this study include the observational nature of prospective cohort data. The effects of navigation may be confounded by physicians' utilization of services for low but not high-risk disease, which is generally treated more promptly. Indeed, we found higher navigation in lower-risk disease, which was also the population with longest time to treatment. Further, there were few barriers to care, and two barriers assessed (distance, income) were calculated by zip code so are estimates. Findings from our rural, predominantly Caucasian state may not be generalizable to other populations, particularly urban, diverse, or lower socioeconomic groups that may also benefit from navigation. Finally, we did not evaluate the association between navigation and treatment selection or other outcomes, but this is planned for future study.

## Conclusions

Patient navigation is a potential intervention to support shared decision making for men with localized prostate cancer. Navigation was significantly associated with longer time to treatment, which may reflect clinically appropriate delays associated with multidisciplinary care or shared decision making facilitated by the navigator. Unlike other cancer navigation programs, time to treatment may not be the ideal metric for evaluating prostate cancer navigation. Shared decision-making facilitation, satisfaction, or clinical or psychosocial outcomes should be explored in greater detail.

**Acknowledgements** Samuel A. Snellings. For assistance with GIS mapping and calculation of travel distances.

**Author contributions** All authors of this research paper have directly participated in the planning, execution, or analysis of the study. In addition, they have read and approved the final version submitted; ECS: Project development, Data collection, management, analysis, Manuscript writing/editing; MH: Protocol/project development, Manuscript editing; GM: Data collection, management, Manuscript editing; AP: Data collection, management, analysis; TR: Data collection, management, Manuscript editing; MF: Data collection, management, Manuscript editing; SCR: Protocol/project development, Manuscript editing; LB: Protocol/project development, Manuscript editing; MH: Protocol/project development, Manuscript editing; TK: Protocol/project development, Manuscript editing; PKJH: Manuscript writing/editing, Manuscript editing; JDS: Protocol/project development, Data collection, management, analysis, Manuscript editing.

## Compliance with ethical standards

**Conflict of interest** The authors have no direct or indirect commercial incentive associated with publishing this article. We have no disclosures for potential conflicts of interest.

**Ethical approval** This manuscript is in full compliance with the requirements of the journal. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

## References

1. National Cancer Institute: Surveillance Epidemiology and End Results Program. SEER Cancer Stat Facts: Prostate Cancer Bethesda, MD (2017) <https://seer.cancer.gov/statfacts/html/prost.html>. Accessed 04 Jan 2017
2. Clegg LX, Reighman ME, Miller BA, Hankey BF, Singh GK, Lin YD et al (2009) Impact of socioeconomic status on cancer incidence and stage at diagnosis: selected findings from the surveillance, epidemiology, and end results: national longitudinal mortality study. *Cancer Causes Control* 20(4):417–435
3. Byers TE, Wolf HJ, Bauer KR, Bolick-Aldrich S, Chen VW, Finch JL et al (2008) The impact of socioeconomic status on survival after cancer in the United States: findings from the national program of cancer registries patterns of care study. *Cancer* 113(3):582–591
4. Hamdy FC, Donovan JL, Lane JA, Mason M, Metcalfe C, Holding P et al (2016) 10-year outcomes after monitoring, surgery, or radiotherapy for localized prostate cancer. *N Engl J Med* 375(15):1415–1424
5. Fleshner K, Carlsson SV, Roobol MJ (2017) The effect of the USPSTF PSA screening recommendation on prostate cancer incidence patterns in the USA. *Nat Rev Urology* 14(1):26–37
6. Danil V, Makarov AF, Kristin Chrouser, John L. Gore, Jodi Maranchie, Matthew E. Nielsen, Christopher Saigal, Christopher Tessier (2015). AUA White Paper on Implementation of Shared Decision Making into Urological Practice: American Urologic Association. <https://www.auanet.org/common/pdf/education/clinical-guidance/Shared-Decision-Making.pdf>. Accessed 04 Jan 2017
7. Légaré F, Stacey D, Turcotte S, Cossi MJ, Kryworuchko J, Graham ID, Lyddiatt A, Politi MC, Thomson R, Elwyn G, Donner-Banzhoff N (2014) Interventions for improving the adoption of shared decision making by healthcare professionals. *Cochrane Database Syst Rev* 15(9):CD006732. <https://doi.org/10.1002/14651858.CD006732.pub3>
8. Violette PD, Agoritsas T, Alexander P, Riikonen J, Santti H, Agarwal A et al (2015) Decision aids for localized prostate cancer treatment choice: systematic review and meta-analysis. *CA Cancer J Clin* 65(3):239–251
9. Johnson DC, Mueller DE, Deal AM, Dunn MW, Smith AB, Woods ME et al (2016) Integrating patient preference into treatment decisions for men with prostate cancer at the point of care. *J Urology* 196(6):1640–1644
10. Freeman HP, Muth BJ, Kerner JF (1995) Expanding access to cancer screening and clinical follow-up among the medically underserved. *Cancer Pract* 3(1):19–30
11. (CoC) CoC. Cancer Program Standards: Ensuring Patient Centered Care (2016 edition). Chicago, IL: American College of Surgeons; 2016
12. Percac-Lima S, Cronin PR, Ryan DP, Chabner BA, Daly EA, Kimball AB (2015) Patient navigation based on predictive modeling decreases no-show rates in cancer care. *Cancer* 121(10):1662–1670

13. Wells KJ, Battaglia TA, Dudley DJ, Garcia R, Greene A, Calhoun E et al (2008) Patient navigation: state of the art or is it science? *Cancer* 113(8):1999–2010
14. Freund KM, Battaglia TA, Calhoun E, Darnell JS, Dudley DJ, Fiscella K et al (2014) Impact of patient navigation on timely cancer care: the patient navigation research program. *J Natl Cancer Inst* 106(6):dju115
15. Raich PC, Whitley EM, Thorland W, Valverde P, Fairclough D (2012) Patient navigation improves cancer diagnostic resolution: an individually randomized clinical trial in an underserved population. *Cancer Epidemiol Biomark Prev* 21(10):1629–1638
16. Whitley EM, Raich PC, Dudley DJ, Freund KM, Paskett ED, Patierno SR et al (2016) Relation of comorbidities and patient navigation with the time to diagnostic resolution after abnormal cancer screening. *Cancer* 123(2):312–318
17. Rodday AM, Parsons SK, Snyder F, Simon MA, Llanos AA, Warren-Mears V et al (2015) Impact of patient navigation in eliminating economic disparities in cancer care. *Cancer* 121(22):4025–4034
18. Guadagnolo BA, Boylan A, Sargent M, Koop D, Brunette D, Kanekar S et al (2011) Patient navigation for American Indians undergoing cancer treatment: utilization and impact on care delivery in a regional healthcare center. *Cancer* 117(12):2754–2761
19. Paskett ED, Harrop JP, Wells KJ (2011) Patient navigation: an update on the state of the science. *CA Cancer J Clin* 61(4):237–249
20. Tingen MS, Weinrich SP, Heydt DD, Boyd MD, Weinrich MC (1998) Perceived benefits: a predictor of participation in prostate cancer screening. *Cancer Nurs* 21(5):349–357
21. Weinrich SP, Boyd MD, Weinrich M, Greene F, Reynolds WA Jr, Metlin C (1998) Increasing prostate cancer screening in African American men with peer-educator and client-navigator interventions. *J Cancer Educat* 13(4):213–219
22. Freund KM, Battaglia TA, Calhoun E, Dudley DJ, Fiscella K, Paskett E et al (2008) National cancer institute patient navigation research program: methods, protocol, and measures. *Cancer* 113(12):3391–3399
23. Memorial Sloan Kettering Cancer Institute. Prostate Cancer Nomograms <https://www.mskcc.org/nomograms/prostate>. Accessed 04 May 2017
24. Eiffler JB, Feng Z, Brian M Lin, Michael T. Partin, Elizabeth B Humphreys, Misop Han, Jonathan I Epstein, Patrick C Walsh, Bruce J Trock, Alan W Partin (2012) An updated prostate cancer staging nomogram (Partin tables) based on cases from 2006 to 2011. <http://urology.jhu.edu/prostate/partintables.php>. Accessed 04 Jan 2017
25. Agency for Healthcare Research and Quality. Knowing Your Options: A Decision Aid for Men with Clinically Localized Prostate Cancer (2011) <http://www.effectivehealthcare.ahrq.gov/ehc/decisionaids/prostate-cancer/>. Accessed 04 Jan 2017
26. Google. Google Maps Distance Matrix API (2016) <https://developers.google.com/maps/documentation/distance-matrix/>. Accessed 04 Jan 2017
27. Lin CC, Bruinooge SS, Kirkwood MK, Olsen C, Jemal A, Bajorin D et al (2015) Association between geographic access to cancer care, insurance, and receipt of chemotherapy: geographic distribution of oncologists and travel distance. *J Clin Oncol* 33(28):3177–3185
28. U.S. Census Bureau. American FactFinder (2010) <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>. Accessed 04 Jan 2017
29. Simon MA, Nonzee NJ, McKoy JM, Liu D, Luu TH, Byer P et al (2013) Navigating veterans with an abnormal prostate cancer screening test: a quasi-experimental study. *BMC Health Serv Res* 13:314
30. van den Bergh RCN, Albertsen PC, Bangma CH, Freedland SJ, Graefen M, Vickers A et al (2013) Timing of curative treatment for prostate cancer: a systematic review. *Eur Urol* 64(2):204–215
31. Song L, Chen RC, Bensen JT, Knafelz GJ, Nielsen ME, Farnan L et al (2013) Who makes the decision regarding the treatment of clinically localized prostate cancer—the patient or physician?: results from a population-based study. *Cancer* 119(2):421–428
32. Ernstmann N, Jaeger J, Kowalski C, Pfaff H, Weissbach L (2013) Elderly prostate cancer patients: patient information and shared decision making. *Der Urologe Ausg A* 52(6):847–852
33. Leow JJ, Leong EK, Serrell EC, Chang SL, Gruen RL, Png KS, et al. (2017) Systematic review of the volume–outcome relationship for radical prostatectomy: A 2017 Update. *Eur Urol Focus*. (Forthcoming)

## Affiliations

Emily C. Serrell<sup>1</sup>  · Moritz Hansen<sup>1,2,3</sup> · Greg Mills<sup>2,3</sup> · Andrew Perry<sup>4</sup> · Tracy Robbins<sup>4</sup> · Melanie Feinberg<sup>4</sup> · Scot C. Remick<sup>4</sup> · Lisa Beaulieu<sup>1,2</sup> · Matt Hayn<sup>1,2</sup> · Tom Kinkead<sup>1,2</sup> · Paul K. J. Han<sup>1,3</sup> · Jesse D. Sammon<sup>1,2,3</sup>

Emily C. Serrell  
emily.serrell@tufts.edu

Moritz Hansen  
hansemo@mmc.org

Greg Mills  
gmills@mmc.org

Andrew Perry  
perrya@mmc.org

Tracy Robbins  
robbitt@mmc.org

Melanie Feinberg  
feinbm@mmc.org

Scot C. Remick  
sremick@mmc.org

Lisa Beaulieu  
beaull@mmc.org

Matt Hayn  
haynm@mmc.org

Tom Kinkead  
kinket@mmc.org

Paul K. J. Han  
hanp@mmc.org

<sup>1</sup> Tufts University School of Medicine, Boston, MA, USA

<sup>2</sup> Division of Urology, Maine Medical Center, Portland, ME, USA

<sup>3</sup> Center for Outcomes Research and Evaluation, Maine Medical Center, 509 Forest Avenue, Suite 200, Portland, ME 04101, USA

<sup>4</sup> Maine Medical Center Cancer Institute, Scarborough, ME, USA