Factors predicting hospital length-of-stay after radical prostatectomy

a population-based study

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National Cancer Registry

Background

- In Europe in 2008 prostate cancer accounted for just under 22% of all new cancers in men

  -Ferlay J., Eur J Cancer 2010

- The Republic of Ireland (RoI), was estimated to have the highest prostate cancer incidence rate in Europe in 2008

  -Ferlay J. et al. Annals of Oncology 2007

- ...due in part to extensive PSA testing and high rates of biopsy.
  - The age at diagnosis is falling and higher proportions have early disease

  - Carsin A. E Cancer Causes and control 2010

- Recent European guidelines on prostate cancer treatment recommend radical prostatectomy (RP) for localised disease in patients with a life expectancy of more than 10 years, who accept treatment-related complications

  - Heidenrech European Urology 2008

So…

- Radical prostatectomy (RP) is a leading option for treatment of early stage prostate cancer in RoI
- ... but relatively little is known about trends in RP and hospital length-of-stay (LOS) following RP at the population level.
- LOS following RP is likely to be major driver of the costs of prostate cancer care.

Study Aim is to investigate

- - trends in prostate cancer incidence and RP for time period 2002-2008
- -factors predicting a longer LOS following radical prostatectomy
  => Baseline for comparisons

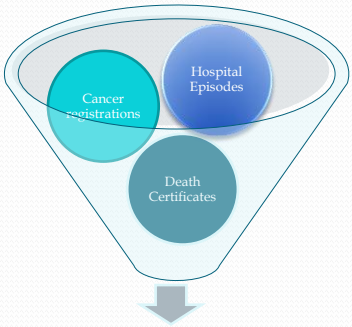
Primary Source Datasets

- Two primary data sources
  - National Cancer Registry data (NCR)
  - Hospital In-Patient Enquiry data (HIPE).
- NCR records demographic, clinical and treatment information for all cancers diagnosed in the population usually resident in Ireland
- HIPE is a computer based health information system that collects data on discharges from acute public hospitals in Ireland.
  - No data from private hospitals
  - HIPE data for cancer episodes only

Study was possible because …

National Cancer Registry

- probabilistic matching
- clerical review



Linked Dataset

Methods 1

National Cancer Registry

- Incident prostate cancers diagnosed January 2002-December 2008
  - in men < 70 years
  - ICD-O2: C61
- Those who had RP (NCRI data) were identified.
  -ICD-9-CM procedure codes 60.3, 60.4, 60.5, 60.62

Methods 2

- HIPE episodes for each cancer record were ordered by date of admission

  overlapping episodes were combined and nested episodes ignored

- The date of RP recorded by NCR was matched by date to the corresponding HIPE episode

=> to identify the index surgery episode

Methods 3

- LOS is the number of days between admission and discharge for the index surgery episode

- Length of discharge is the number of days from discharge from index surgery episode to next admission (if any)

Analysis 1

- Patient characteristics were tabulated
  - RP v no RP
  - Treated in public hospital v treated in private hospital
- LOS was categorized into approximate quartiles based on all cases treated in public hospitals .
- Prolonged hospital stay was defined as a duration greater than the upper limit of the inter-quartile range for all cases (>9 days).

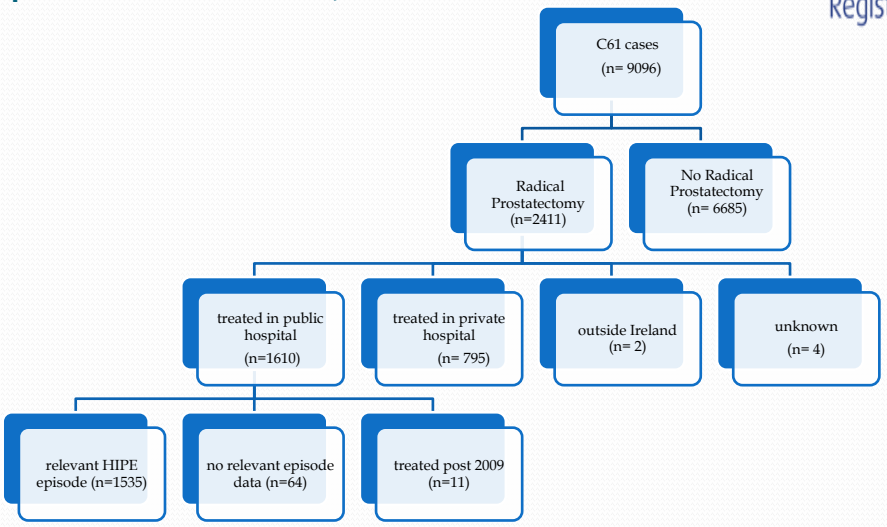
Analysis 2

- Multivariable logistic regression was used to identify factors which predicted a prolonged hospital stay
- Three types of variables were considered:
  - socio-demographic
    - age, marital status, deprivation index, smoking status, discharge status –public or private
  - clinical
    - grade, stage, co-morbidity
  - care
    - hospital volume, consultant volume, admission type (elective, emergency), year of surgery

Stata 11, Model goodness-of-fit was checked using the Hosmer and Lemeshow test

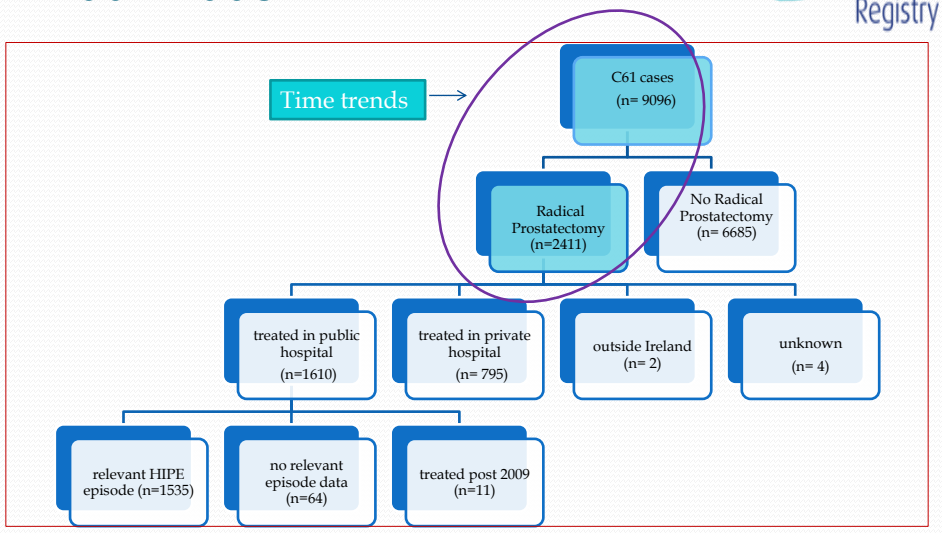
Dataset preparation prostate cancer, 2002-2008

National Cancer Registry



Incident prostate cancer and RP 2002-2008

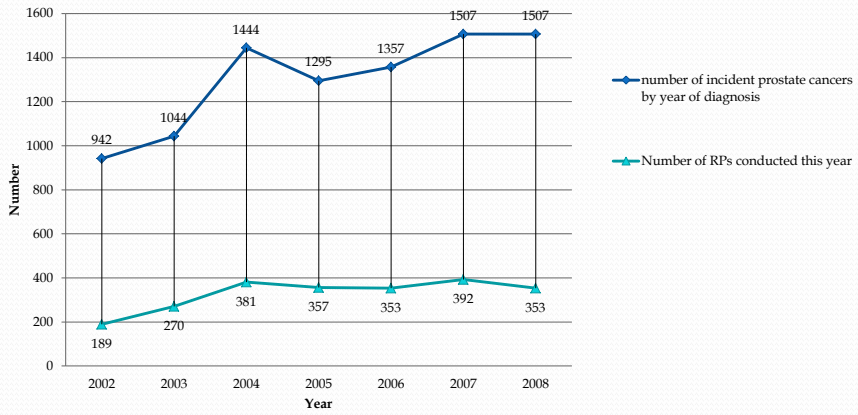
National Cancer Registry



Results: time trends

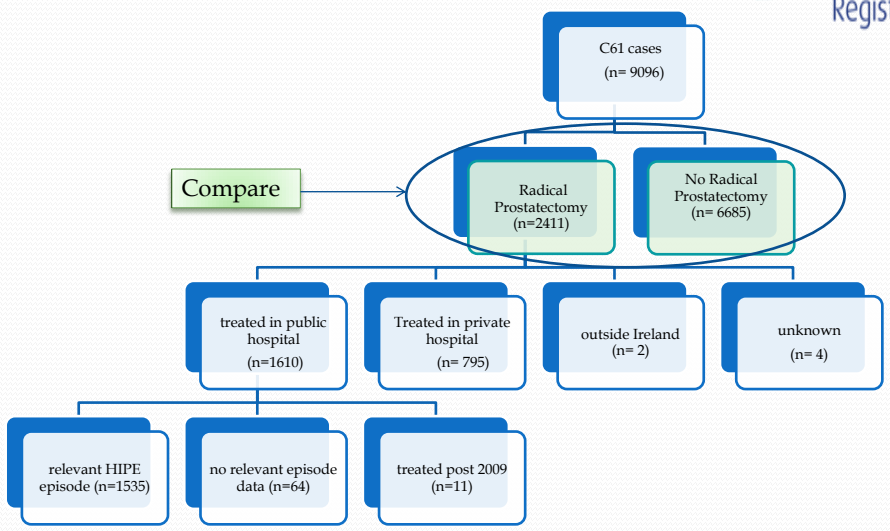
National Cancer Registry

Numbers of incidence prostate cancer case by year of diagnosis, and number of RPs by year of surgery



Results 1

National Cancer Registry



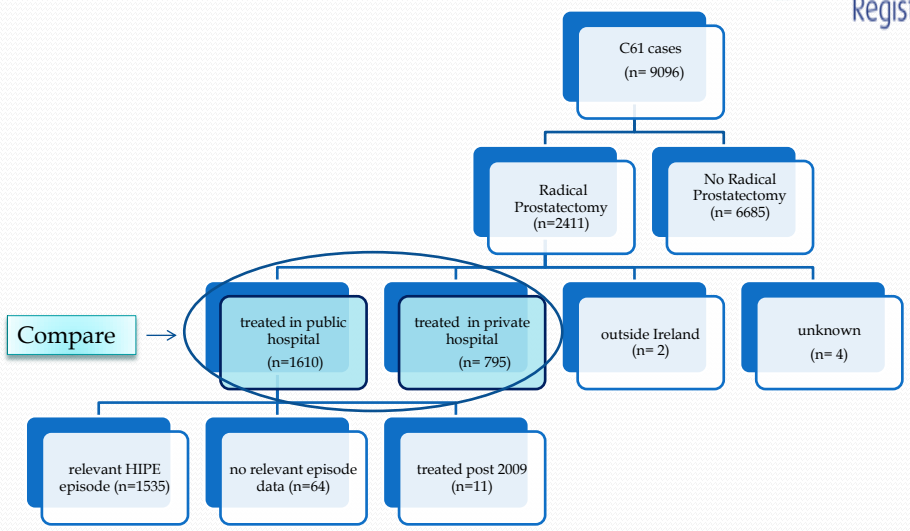
Summary results- RP v no RP

Higher proportions of men having RP

- were younger, (χ^2= 687.4, df = 3, p <0.001)
- married , (χ^2= 154.0, df =2, p<0.001)
- lived in less deprived area at diagnosis , (χ^2 = 42.0, df= 5, p< 0.001)
- never smoked, (χ^2= 306.0, df=2, p< 0.001)
- had lower grade disease, (χ^2= 265.3, df = 2, p<0.001)

Results 2

National Cancer Registry



Summary results- public hospital v private hospital

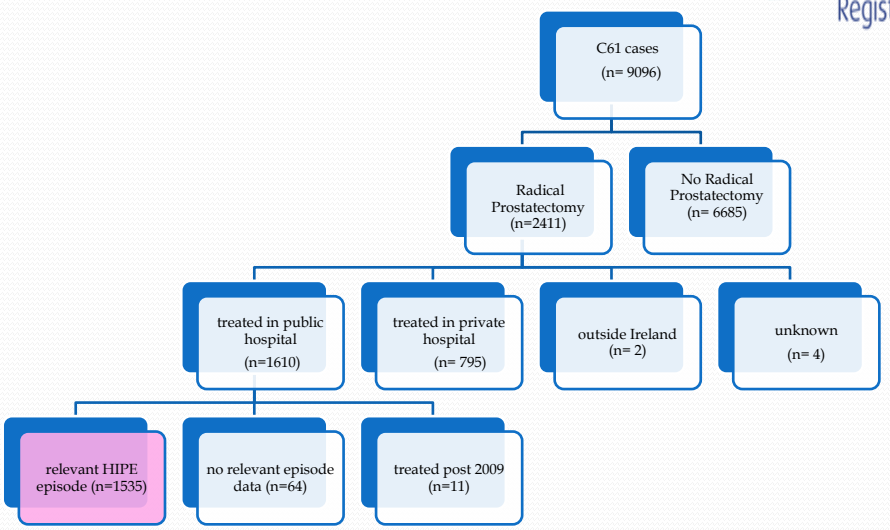
Higher proportions of men treated in public hospitals were

- younger, (χ^2= 13.3, df = 3, p =0.004)
- lived in more deprived area at diagnosis , (χ^2 = 28.7, df= 5, p= 0.001)
- smoked at some point , (χ^2= 61.2, df=2, p=0.001)

No difference in marriage status, or disease grade

Results 3

National Cancer Registry



Median LOS over study period

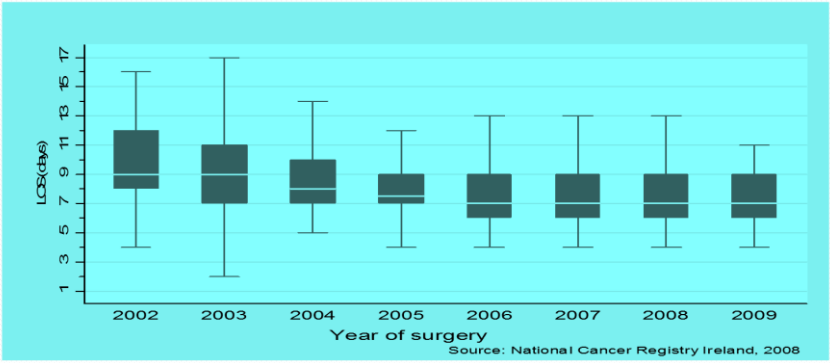


Figure 3: Median LOS with inter-quartile range and adjacent values for RP episode, (public hospitals only).

Differences in median LOS by year of surgery were examined using Cuzick's non-parametric test for trend ($p < 0.001$)

Results – prolonged LOS

- Overall the median LOS was 8 days (IQR = 7-9).
- Prolonged LOS was defined as > 9 days
- Three types of variables were considered:
  - socio-demographic
    - age, marital status, deprivation index, smoking status, discharge status –public or private
  - clinical
    - grade, stage, co-morbidity
  - care
    - hospital volume, consultant volume, year of surgery

Results – predictors of prolonged LOS, demographic

	LOS			LOS > 9 days					
	n =1535 (%)	M[1]	IQR[2]	n=375 (%)	OR[3]	95% CI	OR[4]	95% CI	LRT[5]
Marital status									
Married	1268 (82.6)	8	7-9	287 (76.5)	1.00	-	1.0	-	*p<0.001*
Other	263 (17.1)	8	7-10	87 (23.2)	1.69	1.27-2.25	1.71	1.25-2.34	
Missing	4 (0.3)	6	5-8	1 (0.3)					

Results – predictors of prolonged LOS, clinical

	LOS			LOS > 9 days					
	n =1535 (%)	M[1]	IQR[2]	n=375 (%)	OR[3]	95% CI	OR[4]	95% CI	LRT[5]
Comorbidity									*p<0.001*
None	1127 (73.4)	8	7-9	242 (64.5)	1.00	-	-	-	
Any	408 (26.6)	8	7-10	133 (35.5)	1.77	1.38-2.27	1.64	1.25-2.16	
Stage									
Unknown	1128	8	7-9	255(22.6)	1.00	-	1.00	-	*p<0.001*
I & II	285	8	7-10	75 (26.3)	1.22	0.91-1.65	1.38	0.99-1.92	
III & IV	122	8.5	7-11	45 (37.0)	2.00	1.35-2.96	2.19	1.44-3.34	

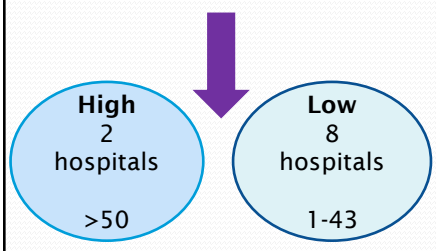
Results – predictors of prolonged LOS, service related

	LOS			LOS > 9 days					
	n =1535 (%)	M[1]	IQR[2]	n=375 (%)	OR[3]	95% CI	OR[4]	95% CI	LRT[5]
Hospital volume[8]									
High (50 or more)	754 (49.1)	7	6-9	126(33.6)	0.43	0.34-0.55	0.34	0.26-0.45	*p<0.001*
Low (less than 50)	781 (50.9)	8	7-10	249 (66.4)	1.00	-	-	-	
Surgeon volume[9]									
High (18 or more)	750 (48.9)	8	7-9	161 (42.9)	0.73	0.58-0.92	0.55	0.42-0.71	*p<0.001*
Low (less than 18)	785 (51.1)	8	7-10	214 (57.1)	1.00	-	-	-	

Volumes

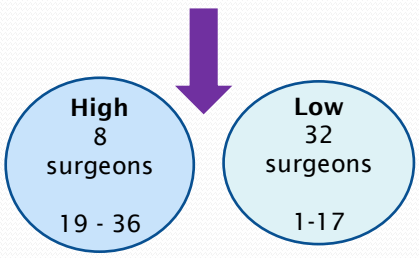
Hospital (public hospitals)

- Number of RP by hospital by year
- Take median value for each hospital
- Sort by median
- Split so 50% of patients fall into high /low category



Surgeon (public & private hospitals)

- Number of RP by surgeon by year
- Take median value for each surgeon
- Sort by median
- Split so 50% of patients fall into high / low category



Results – predictors of prolonged LOS, service related

National Cancer Registry

	LOS			LOS > 9 days					
	n =1535 (%)	M[1]	IQR[2]	n=375 (%)	OR[3]	95% CI	OR[4]	95% CI	LRT[5]
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Conclusions

National Cancer Registry

- Patient and health service-related factors were associated with LOS
  - marital, comorbidity & stage
  - hospital volume & surgeon volume
- These results supports the arguments for increased centralisation of RP services

Strengths

- Population based study
- Study based on high-quality cancer registration data

Weakness and bias

- LOS analysis is limited to patients treated in public hospitals.
  - 33% (n=795)of patients who had RP were treated in private hospitals
- 4% (n=64) patients were recorded by NCRI as having RP in a public hospital - no corresponding HIPE record
  - Reasons for failure to match
    - no cancer diagnosis recorded for the HIPE episode so it is not provided to NCR
    - typographical errors or missing data in either dataset.

Acknowledgements

- ESRI Dublin - HIPE data
- Tumour Registration Officers – data collection
- Data group – data cleaning and linkage
- This work was funded by the Irish Health Research Board

Thank you ...

More detailed results ....

RP versus no RP - demographic

	All prostate (n=9096) (%)	RP - yes (n=2411) (%)	RP - no (n=6685) (%)	X^2 Test
Age at diagnosis				
<55	1085 (11.9)	513 (21.3)	572(8.6)	687.4, p <0.001
55-59	1865 (20.5)	723 (30.0)	1142 (17.1)	
60-64	2727 (30.0)	718 (29.8)	2009 (30.1)	
Marital status				
Married	6706 (73.7)	2006 (83.2)	4700 (70.3)	154.0, p<0.001
Other	2312 (25.4)	397 (16.5)	1915(28.6)	
missing	78 (0.9)	8 (0.3)	70 (1.0)	

Higher proportion of men having RP are younger, married

RP versus no RP - demographic

	All prostate (n=9096) (%)	RP - yes (n=2411) (%)	RP - no (n=6685) (%)	X^2 Test
Deprivation index[2]				
1 (least)	2051 (22.5)	633 (26.3)	1418 (21.2)	42.0 p< 0.001
2	1203 (13.2)	319 (13.2)	884 (13.20	
3	1190 (13.1)	320 (13.3)	870 (13.0)	
4	1483 (16.3)	408 (16.9)	1075 (16.1)	
5 (most)	2227 (24.5)	498 (20.7)	1729 (25.9)	
missing	942 (10.4)	233 (9.7)	709 (10.6)	
Smoking status				
Ever	2551 (28.0)	741 (30.7)	1810 (27.1)	306.9, p< 0.001
Never	2828 (31.1)	1025 (42.5)	1803 (27.0)	
unknown	3717 (40.9)	645 (26.7)	3072(45.9)	

Higher proportion of men having RP are younger, married, less deprived,

RP versus no RP - clinical

	All prostate(n=9096) (%)	RP - yes (n=2411) (%)	RP - no (n=6685) (%)	X^2 Test
Grade/Gleason score				
Low/intermed (GS<= 7)	6799 (74.7)	2088 (86.6)	4711 (70.5)	265.3, p<0.001
High (GS>7)	1391 (15.3)	243 (10.1)	1148 (17.2)	
Other	906 (10.0)	80 (3.3)	826 (12.4)	
Stage				
I & II	1617 (17.8)	449 (18.6)	1168 (17.5)	43.9, p<0.001
III & IV	1038 (11.4)	187 (7.8)	851 (12.7)	
unknown	6439 (70.8)	1774 (73.6)	4665 (69.8)	
missing	2 (0.02)	1 (0.0)	1 (0.0)	

Higher proportion of men having RP are younger, married, less deprived, lower grade disease

RP: Public v. Private - demographic

National Cancer Registry

	All RPs[1] (n=2411) (%)	Public hosp (n=1610) (%)	Private hosp (n=795) (%)	X^2 Test
Age at diagnosis				
<55	513 (21.3)	370 (23.0)	143 (18.0)	13.3, p=0.004
55-59	723 (30.0)	481 (29.9)	240 (30.2)	
60-64	718 (29.8)	481 (29.9)	235 (29.6)	
65-69	457 (18.9)	278 (17.3)	177 (22.3)	
Marital status				
Married	2006 (82.2)	1334 (82.9)	667 (83.9)	0.61, p=0.435
Other	397 (16.5)	272 (16.9)	124 (15.6)	
missing	8 (0.3)	4 (0.2)	4 (0.5)	

A higher proportion of men treated publicly were younger,

RP: Public v. Private - demographic

National Cancer Registry

	All RPs[1] (n=2411) (%)	Public hosp (n=1610) (%)	Private hosp (n=795) (%)	X^2 Test
Deprivation index[2]				
1 (least)	633 (26.3)	417 (25.9)	216 (27.2)	22.6, p <0.001
2	319 (13.2)	203 (12.6)	115 (14.5)	
3	320 (13.3)	207 (12.9)	111 (14.0)	
4	408 (16.9)	257 (16.0)	149(18.7)	
5 (most)	498 (20.7)	377 (23.4)	121 (15.2)	
missing	233 (9.7)	149 (9.2)	83 (10.4)	
Smoking status				
Ever	741 (30.7)	545 (33.8)	196 (24.6)	60.6, p< 0.001
Never	1025 (42.5)	712 (44.2)	308 (38.7)	
unknown	621 (25.8)	339 (21.1)	281 (35.3)	
missing	24 (1.0)	14 (0.9)	10 (1.3)	

A higher proportion of men treated publicly were younger, more deprived

RP: Public v Private - clinical

	All RPs (n=2411) (%)	Public hosp (n=1610) (%)	Private hosp (n=795) (%)	X^2 Test
Grade/Gleason score				
Low/intermed (GS<= 7)	2088 (86.6)	1408 (87.4)	678 (85.3)	2.3
High (GS>7)	243 (10.1)	151 (9.4)	90 (11.3)	p=0.305
Other	80 (3.3)	51 (3.2)	27 (3.4)	
Stage				
I & II	449 (18.6)	304 (18.8)	144 (18.1)	2.3
III & IV	187 (7.8)	131 (8.1)	54 (6.8)	p=0.521
unknown	1774 (73.6)	1174 (72.9)	597 (75.1)	
missing	1 (0.0)	1 (0.1)	0 (0.0)	

A higher proportion of men treated publicly were younger, more deprived, X

[1]6 patients treated outside Ireland or in 'unknown' hospitals, [2]SAHRU 2002 index of deprivation

Results – predictors of prolonged LOS

	LOS			LOS > 9 days					
	N	M[1]	IQR[2]	N (%)	OR[3]	95% CI	OR[4]	95% CI	p-value[5]
Age at diagnosis									
<55	353	7	7-9	76 (21.5)	0.86	0.62-1.60	-	-	
55-59	460	8	7-9	111 (24.1)	1.00	-	-	-	
60-64	455	8	7-10	118 (25.9)	1.10	0.82-1.48	-	-	
65-69	267	8	7-10	70 (26.2)	1.11	0.79-1.58	-	-	
Marital status									
Married	1268	8	7-9	287 (22.6)	1.00	-	1.0	-	*p<0.001*
Other	263	8	7-10	87 (33.1)	1.69	1.27-2.25	1.71	1.25-2.34	
Missing	4	6	5-8	1 (25.0)					
Smoking Status									
Ever	521	8	7-9	122 (23.4)	0.87	0.67-1.14	-	-	
Never	686	8	7-10	178 (25.9)	1.0	-	-	-	
Unknown	328	8	6-9	75 (22.8)	0.85	0.62-1.15	-	-	
Deprivation Index[6]									
1 (least deprived)	400	8	7-9	82 (20.5)	1.00	-	-	-	
2	193	8	7-9	41 (21.2)	1.05	0.69-1.59	-	-	
3	197	8	7-10	55 (27.9)	1.50	1.01-2.23	-	-	
4	246	8	7-9	61 (24.8)	1.28	0.88-1.87	-	-	
5 (most deprived)	360	8	7-10	99 (27.5)	1.47	1.05-2.06	-	-	
Missing	139	8	7-10	37 (26.6)	1.41	0.90-2.20	-	-	
Comorbidity[7]									
None	1127	8	7-9	242 (21.5)	1.00	-	1.0	-	*p<0.001*
Any	408	8	7-10	133 (32.6)	1.77	1.38-2.27	1.64	1.25-2.16	

Results – predictors of prolonged LOS

National Cancer Registry

	LOS			LOS >9 days					
	N =1535 (%)	**M[1]**	**IQR[2]**	**N (%)**	**OR[3]**	**95% CI**	**OR[4]**	**95% CI**	**p-value[5]**
Grade/Gleason Score									
Low/intermed (GS<= 7)	1345	8	7-9	321 (23.9)	1.00	-	-	-	
High (GS>7)	147	8	7-10	39 (26.5)	1.15	0.78-1.70	-	-	
Unknown	43	8	7-11	15 (34.9)	1.71	0.90-3.24	-	-	
Stage									
Unknown	1128	8	7-9	255 (22.6)	1.00	-	1.00	-	*p<0.001*
I & II	285	8	7-10	75 (26.3)	1.22	0.91-1.65	1.38	0.99-1.92	
III & IV	122	8.5	7-11	45 (37.0)	2.00	1.35-2.96	2.19	1.44-3.34	
Patient status									
Public	618	8	7-9	145 (23.5)	1.00	-	-	-	
Private	805	7	7-9	176 (21.9)	0.91	0.71-1.17	-	-	
Missing	112	9	8-12	54 (48.2)	3.03	2.01-4.60	-	-	
Hospital volume[8]									
High (50 or more)	754	7	6-9	126(16.7)	0.43	0.34-0.55	0.34	0.26-0.45	*p<0.001*
Low (less than 50)	781	8	7-10	249 (31.9)	1.00	-	1.0	-	
Surgeon volume[9]									
High (18 or more)	750	8	7-9	161 (21.5)	0.73	0.58-0.92	0.55	0.42-0.71	*p<0.001*
Low (less than 18)	785	8	7-10	214 (27.3)	1.00	-	1.0	-	

[1]median [2] Inter-quartile range [3]unadjusted odds ratio, [4]adjusted odds ratio for variables shown; model also adjusted for year of surgery, [5]global p-values from likelihood ratio tests, [6]SAHRU 2002 index, [7]count of morbidities included in the Elixhauser index on HIPE record of RP episode, [8]median number of RPs performed at hospital per year, [9]median number of RP performed by surgeon per year in public and private hospitals