Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.
eTable 1. Clinical and Resource Utilization Parameters

|                      | Base Case Value | Range | Distribution | Source       |
|----------------------|-----------------|-------|--------------|--------------|
|                      | Lower-bound     | Upper-bound     |              |              |
| Perioperative        |                 |                   |              |              |
| Operating room (mins)|                 |                   |              |              |
| ORP                  | 179.03          | 129.91           | 170.91       | Gamma        | DeCarlo 2013 |
| LRP                  | 236.54          | 182.91           | 240.91       | Gamma        | DeCarlo 2013 |
| RARP                 | 187.91          | 150.33           | 225.49       | Gamma        | DeCarlo 2013 |
| Length of Stay       |                 |                   |              |              |
| ORP                  | 4.7             | 3.76             | 5.64         | Gamma        | Laird 2015   |
| LRP                  | 2.9             | 2.32             | 3.48         | Gamma        | Laird 2015   |
| RARP                 | 2.5             | 2.00             | 3.00         | Gamma        | Laird 2015   |
| Conversion to Open   |                 |                   |              |              |
| LRP                  | 1.60%           | 1.28%            | 1.92%        | Beta         | Laird 2015   |
| RARP                 | 0.00%           | 0.00%            | 1.92%        | Beta         | Laird 2015   |
| Complication         |                 |                   |              |              |
| ORP                  |                 |                   |              |              |
| Clavien 1            | 4.00%           | 3.20%            | 4.80%        | Beta         | Yaxley 2016  |
| Clavien 2            | 2.00%           | 1.60%            | 2.40%        | Beta         | Yaxley 2016  |
| Clavien 3a           | 1.30%           | 1.04%            | 1.56%        | Beta         | Yaxley 2016  |
| Clavien 3b           | 2.00%           | 1.60%            | 2.40%        | Beta         | Yaxley 2016  |
| Clavien 4            | 1.30%           | 1.04%            | 1.56%        | Beta         | Yaxley 2016  |
| LRP                  |                 |                   |              |              |
| Clavien 1            | 4.10%           | 3.28%            | 4.92%        | Beta         | Robertson 2013 |
| Clavien 2            | 7.20%           | 5.76%            | 8.64%        | Beta         | Robertson 2013 |
| Clavien 3a           | 1.30%           | 1.04%            | 1.56%        | Beta         | Robertson 2013 |
|                  | Clavien 3b | Clavien 4 | Clavien 2 | Clavien 3a | Clavien 3b | Clavien 4 |
|------------------|-----------|----------|-----------|-----------|-----------|----------|
|                  | 3.60%     | 2.88%    | 4.32%     | 0.60%     | 0.00%     | 0.00%    |
|                  | 2.88%     | 0.64%    | 0.96%     | 0.48%     | 0.00%     | 0.00%    |
|                  | 4.32%     | 2.00%    | 3.00%     | 0.72%     | 0.00%     | 0.00%    |
|                  | 0.00%     | 1.04%    | 1.56%     | 0.00%     | 0.00%     | 0.00%    |
|                  | 0.00%     | 0.00%    | 0.00%     | 0.00%     | 0.00%     | 0.00%    |
|                  | 0.00%     | 0.00%    | 0.00%     | 0.00%     | 0.00%     | 0.00%    |
| Mortality        |           |          |           |           |           |          |
| ORP              | 0.1%      | 0.7%     | 13.0%     |           |           |          |
| LRP              | 0.04%     | 0.03%    | 0.05%     |           |           |          |
| RARP             | 0.04%     | 0.01%    | 0.08%     |           |           |          |
| functional Outcome |         |          |           |           |           |          |
| Sexual dysfunction |      |          |           |           |           |          |
| ORP              | 49%       | 39.2%    | 58.8%     |           |           |          |
| LRP              | 40%       | 32%      | 48%       |           |           |          |
| RARP             | 28%       | 22.4%    | 33.6%     |           |           |          |
| Urinary incontinence |       |          |           |           |           |          |
| ORP              | 11%       | 8.8%     | 13.2%     |           |           |          |
| LRP              | 10%       | 8%       | 12%       |           |           |          |
| RARP             | 9%        | 7.2%     | 10.8%     |           |           |          |
| Bladder neck contracture |   |          |           |           |           |          |
| ORP              | 4.5%      | 3.6%     | 5.4%      |           |           |          |
| LRP              | 2.1%      | 2%       | 3%        |           |           |          |
| RARP             | 0.8%      | 0.064%   | 0.096%    |           |           |          |
| Receiving Salvage Therapy after BCR |     |          |           |           |           |          |
| Radiation therapy | 20.0%     | 16%      | 24%       |           |           |          |

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| Description                                                                 | ADT  | ADT+Radiation therapy | Hazard Ratio: BCR RARP vs. ORP (ref) (1-5 years) | Hazard Ratio: BCR RARP vs. ORP (ref) (5+ years) | Risk Ratio BCR RARP vs. LRP (ref) (1-5 years) | Annual transition probability from recurrence to metastasis state | Annual survival rate for metastatic disease | Reference       |
|----------------------------------------------------------------------------|------|-----------------------|-----------------------------------------------|-----------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------|
| Transitional Probability                                                   |      |                       |                                               |                                               |                                             |                                             |                                             |                |
| Transitional probability from surveillance to recurrence                   | 0.8  | 0.64                  | 0.81                                          | 0.62                                          | 0.89                                        | 0.72                                        | 0.59                                        | Wang 2017      |
| 5-yr RARP Biochemical free survival rate (%)                               | 0.64 | 0.96                  | 1.06                                          | 1.10                                          | 0.73                                        | 8.4%                                        |                                             | Wang 2017      |
| Hazard Ratio: BCR RARP vs. ORP (ref) (5+ years)                            | 0.89 | 1.06                  | 1.06                                          | 1.10                                          | 0.73                                        | 8.4%                                        |                                             | Wang 2017      |
| Risk Ratio BCR RARP vs. LRP (ref) (1-5 years)                              | 0.59 | 0.73                  |                                               |                                               |                                             |                                             |                                             | Lee 2017       |
| Annual transition probability from recurrence to metastasis state          | 7%   | 5.6%                  | 8.4%                                          |                                               |                                             |                                             |                                             | Crook 2012, Prackel 2020 |
| Annual survival rate for metastatic disease                                | 33%  | 27%                   | 40%                                           |                                               |                                             |                                             |                                             | Close 2013, Bria 2009 |

Abbreviation: BCR, biochemical recurrence; LRP, laparoscopic radical prostatectomy; mins, minutes; ORP, open radical prostatectomy, RARP, robotic-assisted radical prostatectomy; ADT, androgen deprivation therapy; yr, year.
# eTable 2. Utility Parameters

| Utilities                  | Base case | Lower-bound | Upper-bound | Distribution | Source          |
|----------------------------|-----------|-------------|-------------|--------------|-----------------|
| Progression-free utility   | 0.9       | 0.72        | 0.95        | Beta         | Korfage 2005    |
| Biochemical recurrence utility | 0.73   | 0.584       | 0.876       | Beta         | Cowen 1998      |
| Localized recurrence utility | 0.82   | 0.656       | 0.95        | Beta         | Korfage 2005    |
| Distant metastasis utility  | 0.42      | 0.336       | 0.504       | Beta         | Cowen 1998      |
| Erectile disfunction utility | 0.84   | 0.672       | 0.95        | Beta         | Volk 2004       |
| Urinary incontinence utility | 0.83   | 0.664       | 0.95        | Beta         | Volk 2004       |
| Bladder neck contracture utility | 0.72   | 0.576       | 0.864       | Beta         | Volk 2004       |
## eTable 3. Cost Parameters in the Model

| Parameter                                      | Base case | Lower-bound | Upper-bound | Distribution | Source                                                                 |
|------------------------------------------------|-----------|-------------|-------------|--------------|------------------------------------------------------------------------|
| **Hospitalization costs**                     |           |             |             |              |                                                                        |
| OR cost per hour                              | £1,220    | £976        | £1,464      | Gamma        | ISD 2019                                                              |
| Hospital stay cost per day                    | £444      | £368        | £551        | Gamma        | NHS reference cost 2017-2018 inflation adjusted to 2019 £             |
| **Cost per type of complication**             |           |             |             |              |                                                                        |
| Clavien 1                                     | £444      | £355        | £533        | Gamma        | Assumption (1 additional LOS)                                         |
| Clavien 2                                     | £888      | £710        | £1,066      | Gamma        | Assumption (2 additional LOS)                                         |
| Clavien 3a                                    | £1,332    | £1,066      | £1,598      | Gamma        | Assumption (3 additional LOS)                                         |
| Clavien 3b                                    | £1,332    | £1,066      | £1,598      | Gamma        | Assumption (3 additional LOS)                                         |
| Clavien 4                                     | £1,776    | £1,421      | £2,131      | Gamma        | Assumption (4 additional LOS)                                         |
| **Dysfunction costs**                         |           |             |             |              |                                                                        |
| Annual sexual dysfunction costs               | £419      | £335        | £502        | Gamma        | Micro-costing/eTable 5                                               |
| Annual urinary incontinence costs             | £891      | £713        | £1,069      | Gamma        | Micro-costing/eTable 5                                               |
| On-time BNC costs(LB26A LB26B)                | £1,969    | £1,575      | £2,363      | Gamma        | NHS reference cost 2018-2019                                         |
| **Surveillance costs**                        |           |             |             |              |                                                                        |
| 1 urology follow-up visit                     | £105      | £84         | £126        | Gamma        | NHS reference cost 2018-2019                                         |
| **Salvage therapy costs**                     |           |             |             |              |                                                                        |
| Annual management costa                       | £1,579    | £1,263      | £1,895      | Gamma        | NHS reference cost 2018-2019                                         |
| Radiation treatment costs (SC24Z)             | £11,974   | £9,579      | £14,369     | Gamma        | NHS reference cost 2018-2019                                         |
| ADT (Lupron for 6 months)                     | £451      | £361        | £542        | Gamma        | BNF 2020                                                              |
| Radiation therapy adverse event treatment costs (One time) | £1,188 | £951 | £1,426 | Gamma | Micro-costing |
| **Distant metastasis treatment costs**        |           |             |             |              |                                                                        |
| One-time treatment                            | £12,018   | £9,614      | £14,421     | Gamma        | NHS reference cost 2018-2019                                         |
| Annual metastatic management                  | £1,799    | £1,439      | £2,158      | Gamma        | Micro-costing                                                        |
| Palliative care treatment costs               | £10,659   | £8,527      | £12,791     | Gamma        | PSSRU 2019                                                            |

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### Non-NHS costs

| Perioperative 3-month work loss |  |  |  |
|--------------------------------|----------------|----------------|----------------|
| Work hours lost                | £53            | £43            | £64            |
| Wage/year                      | £17,234        | £12,354        | £18,531        |
| Annual Informal care costs     | £20.4          | £6.6           | £45.7          |
| Annual patient out-of-pocket costs | £9           | £2.7           | £14.3          |
| Work productivity lost per PC related death | £21,697 | £15,554 | £23,330 |
| In home productivity lost per PC related death | £190,883 | £136,833 | £205,250 |

Abbreviation: NHS, National Health Services; OR, operating room; PC, prostate cancer; BNC, bladder neck contracture; ADT, androgen deprivation therapy

a. Annual cost include the cost for one PET Scan (RN03A) + One Cancer Multi-Disciplinary Visit + One Follow-up consultant with Urology and Nuclear Medicine (WF02A)

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### eTable 4. Surgical Equipment Cost

| Parameter                                                                 | Base case | Lower-bound | Upper-bound | Distribution | Source                        |
|--------------------------------------------------------------------------|-----------|-------------|-------------|--------------|-------------------------------|
| da Vinci capital cost per procedure (dV X Single Console)                | £663      |             |             |              | Calculation                   |
| da Vinci System Price                                                    | £1,100,000| £88,000     | £1,320,000  | Gamma        | ISI Listing price             |
| Add-on                                                                   | £60,000   | £40,000     | £80,000     | Gamma        | ISI Listing price             |
| Depreciation year                                                        | 7         | 5           | 10          | Triangular   | Close 2013                    |
| Annual Volume                                                            | 250       | 100         | 400         | Triangular   | ISI internal estimate         |
| da Vinci service cost per procedure<sup>a</sup>                          | £411      |             |             |              | Calculation                   |
| Annual Service Price                                                     | £120,000  | 95000       | 135000      | Gamma        | ISI Listing price             |
| da Vinci instrument and consumesables                                    | £1,697    | £1,188      | £1,503      | Gamma        | SMB 2018, ISI Listing price based |
| Laparoscopic instrument and surgical consumables<sup>b</sup>             | £1,350    | £945        | £1,755      | Gamma        | SMB 2018                     |
| Open surgical consumables<sup>b</sup>                                    | £638      | £300        | £829        | Gamma        | SMB 2018                     |

<sup>a</sup> The 1st year service included in the capital installment contract

<sup>b</sup> Original data is reported in Swiss France, converted to pound sterling.
**eTable 5. Micro-costing for the Treatment Cost Associated With Dysfunctional Outcome**

| Clinical Parameters | Base case | Lower-bound | Upper-bound | Reference |
|---------------------|-----------|-------------|-------------|-----------|
| Use of Urinary sphincter implantation for urinary incontinence | 0.05 | 0.04 | 0.07 | Cooperberg 2013 |

**Unit Cost of Treatment for Urinary incontinence:**

| Clinical Parameters | Base case | Lower-bound | Upper-bound | Reference |
|---------------------|-----------|-------------|-------------|-----------|
| Self-management of urinary incontinence (Yearly) | £329 | £263.00 | £395.00 | Close 2013* |
| Implantation artificial urinary sphincter (LB50Z) | £4,702 | £3,762.00 | £5,643.00 | NHS Reference Cost 2018-2019 |
| Device Cost | £6,863 | £5,491.00 | £8,236.00 | Close 2013* |
| Cost for urinary Incontinence per year per patient | £891 | £610 | £1,292 | Calculation |

**Erectile dysfunction (Duration 2 years)**

| Clinical Parameters | Base case | Lower-bound | Upper-bound | Reference |
|---------------------|-----------|-------------|-------------|-----------|
| Use of treatment and outcome for erectile dysfunction | | | | |
| Trial of sildenafil | 0.82 | 0.62 | 1 | Schover 2002 |
| Trial of alprostadil | 0.15 | 0.12 | 0.19 | Blander 2000 |
| Penile prosthesis implantation | 0.002 | 0.002 | 0.003 | Schover 2002 |
| Treatment for erectile dysfunction: | | | | |
| Implantation penile prosthesis (LB47Z) | £5,536 | £4,429 | £6,643 | NHS Reference Cost 2018-2019 |
| Device Cost | £7,220 | £5,023 | £8,023 | Close 2013* |
| Tablet Viagra (Sildenafil), One each weekly | £5.87 | £5 | £8 | BNF 2020 |
| Injection Caverject (Alprostadil), One each weekly | £14.70 | £12 | £18 | BNF 2020 |
| Cost for dysfunction per year per patient | £419 | £273 | £675 | Calculation |

Abbreviation: NHS, National Health Services
## eTable 6. Micro-costing for the Cost Associated With Radiation Therapy Adverse Event

| Clinical Events                                | Probability | Lower-bound | Upper-bound | Reference                  |
|------------------------------------------------|-------------|-------------|-------------|----------------------------|
| Bladder neck contracture                       | 0.178       | 0.14        | 0.21        | Thompson et al. [11]       |
| Bleed                                          | 0.03        | 0.026       | 0.039       | Feng et al. [30]           |
| Fracture                                       |             |             |             |                            |
| Receive ADT                                    | 0.1         | 0.08        | 0.13        | Thompson et al. [11]       |
| Fracture with ADT                              | 0.187       | 0.069       | 1           | Krupski et al. [31]        |
| Fracture without ADT                           | 0.146       | 0.033       | 0.49        | Krupski et al. [31]        |

| Unit Cost                                      | Lower-bound | Upper-bound | Reference                  |
|------------------------------------------------|-------------|-------------|----------------------------|
| Rectal bleeding treatment (2 colonoscopies + 1 YAG laser coagulation) | £3,561      | £3,001      | £4,769                     | Calculated                  |
| Therapeutic colonoscopy (FE30Z)                | £812        | £650        | £974                      | NHS Reference Cost 2018-2019 |
| Percutaneous transluminal, laser or radiofrequency ablation (YR30Z, YR31Z) | £1,936.98   | £1,1702     | £2,820                     | NHS Reference Cost 2018-2019 |
| Bladder neck contracture treatment (2 cystoscopies + cytoscopy with dilation) LB72A | £3,954      | £3,163      | £4,745                     | NHS Reference Cost 2018-2019 |
| Fracture                                       |             |             |                            |
| Fracture                                       |             |             |                            |
| **Total Cost per patients with radiation therapy** | **£1,188**  | **£840**    | **£8,157**                |

Abbreviation: NHS, National Health Services; ADT, androgen deprivation therapy
### eTable 7. Micro-costing for the Cost Associated With Distant Metastasis

#### Treatment

|                          | Estimate  | Resource                  |
|--------------------------|-----------|---------------------------|
| Annual management        | £1,799    | Calculated                |
| LHRH agonist gosereline acetate (£70 per 28 days) | £912.50   | BNF 2020                  |
| One PET scan (RN03A)     | £776.00   | NHS Reference 2018-2019   |
| One cancer multi-disciplinary visit | £110.00   | NHS Reference 2018-2019   |
| **One-time treatment**   | **£12,018** | Calculated                |
| 14-day course of cyproterone acetate | £43.50 | BNF 2020                  |
| Radiation (SC24Z), 33 session | £11,974.16 | NHS Reference 2018-2019   |

Abbreviation: NHS, National Health Services; LHRH, luteinizing hormone-releasing hormone
eFigure 1. Deterministic Sensitivity Analysis

A) RARP vs. ORP

Biochemical hazard Ratio RARP vs. ORP (Years 1 to 5) (0.62,1.06)
Average volume of RAS per system (100,400)
OR time of RARP (2.51,3.76)
Length of stay of ORP (3.76,5.64)
OR time of ORP (2.17,2.85)
Cost of RARP I&A (1358,2036)

Biochemical hazard Ratio RARP vs. ORP (After 5 Years) (0.72,1.10)
One time cost for metastasis treatment (2635,49547)
Annual cost of BCR without Salvage therapy (996,3981)
Length of stay of RARP (2,3)
Cost of system cost for RAS per case (859,1289)
Cost of Hospital Stay per Day (355,533)
Utility of surveillance (0.72,0.95)
coefficient of BCR after RARP (exponential) (-0.05,-0.04)
Cost of ORP I&A (510,766)
B) RARP vs. LRP

Abbreviation: BCR, biochemical recurrence; I&A, instruments and Accessory; ICER, incremental cost-effectiveness ratio; LRP, laparoscopic radical prostatectomy; OR, operating room; ORP, open radical prostatectomy; RARP, robotic-assisted radical prostatectomy.
eFigure 2. Cost-effectiveness Acceptability Curve at Willingness-to-Pay

Abbreviation: CE, cost-effectiveness; LRP, laparoscopic radical prostatectomy; ORP, open radical prostatectomy; RARP, robotic-assisted radical prostatectomy.
eFigure 3. The ICER Plane of RARP vs ORP and RARP vs LRP From Monte Carlo Simulation

A) Incremental Cost-Effectiveness, RARP v. ORP

B) Incremental Cost-Effectiveness, RARP v. LRP

Abbreviation: ICER, incremental cost-effectiveness ratio; LRP, laparoscopic radical prostatectomy; ORP, open radical prostatectomy; QALY, quality-adjusted life year; RARP, robotic-assisted radical prostatectomy; WTP, willingness-to-pay.
COST EFFECTIVENESS OF ROBOTIC-ASSISTED RADICAL PROSTATECTOMY FOR LOCALIZED PROSTATE CANCER IN THE UNITED KINGDOM

Authors: Chao Song; Yanli Li
1. Rational and Background

Prostate cancer is one of the most common cancers for males. Surgery is the standard treatment for localized prostate cancer. The main type of surgery for prostate cancer is radical prostatectomy, during which the surgeon removes the entire prostate gland plus some of the surrounding tissue, including the seminal vesicles.

Prostatectomy can be performed using an open surgical or minimally invasive approach (laparoscopic or robot-assisted). During open radical prostatectomy (ORP), the surgeon operates through a single, long skin incision to remove the prostate and nearby tissues. Minimally invasive prostatectomy requires smaller incisions to perform the procedure. Despite being a less invasive approach, compared to open surgery, routine clinical application of laparoscopic radical prostatectomy (LRP) is low, possibly due to its technical difficulty (Carter 2014, Cazzaniga 2019). During robotic-assisted radical prostatectomy (RARP), da Vinci system translates every hand movement the surgeon makes in real time to bend and rotate the instruments with precision. A camera provides a high definition, 3D magnified view inside the body.

The clinical benefits of performing RARP has been reported in many peer-reviewed literatures. Compared with ORP, RARP has been shown to reduce postoperative complications (blood loss & transfusion rate), hospital length of stay (LOS), and enable faster recovery (Yaxley 2016). Compared with conversional LRP, RARP offers technical advantage to overcome the challenges from the complexity of radical prostatectomy and enables more patients to benefit from minimally invasive techniques [Yu 2012].

The major concern to adopt RARP is its cost effectiveness. The UK National Institute for Clinical Excellence (NICE) made a recommendation of using RARP for the resection of localized prostate cancer among high volume centers (more than 150 case per system per year) (Ramsay NHIR 2012). Adoption of RARP has been increased rapidly and accompanied by a decrease in use of ORP in the UK. Proportion of RARP procedures among all the radical prostatectomies has been increased from 15% in 2008, to 85% in 2018, and the use of LRP reduced from 32% to less than 4% and ORP use decreased from 53% to 11% (Hughes 2016, NHS HRG 2018-2019).

The previous cost-effectiveness assessment of prostatectomy in the UK only assessed RARP vs. LRP, but did not consider ORP (Ramsay NHIR 2012/Close 2013). Since the last assessment, more robust long-term clinical outcome data after prostatectomy have emerged (Lee 2017, Wang 2017). In addition, robotic-assisted surgery continues to evolve over time and increasing number of procedures were performed per system in the UK, which will lead
to reduction in capital cost per procedure. All these highlight the importance of performing an updated cost-effectiveness analysis to compare different surgical approaches of prostatectomy in the UK.

2. Objectives and Research Questions

The current study aims to examine the cost-effectiveness of robotic-assisted, conventional laparoscopic and open radical prostatectomy for localized prostate cancer from the UK National Health Service (NHS) perspective.

3. Study design

3-1. General description

Based on the current understanding of the clinical treatment pathway and previous economic evaluations, a Markov cohort model will be developed to simulate the cost-effectiveness of RARP compared with ORP and LRP.

| Perspective | Primary (base case): UK NHS  
| Secondary (scenario analysis): Societal |
| Time Horizon | Primary (base case): 10 years  
| Secondary (scenario analysis): Lifetime (start at age 65-yr and follow up for 40 yrs.) |
| Population | 65-year-old patients with localized prostate cancer receiving radical prostatectomy |
| Comparators | RARP vs. LRP; RARP vs. ORP |
| Choice of Model | Markov Cohort Model |
| Cycle Length | 1 Year |
| Outcomes | Health Outcomes: QALY  
| Cost measurements:  
| • Direct medical costs (Base case)  
| • Direct medical + Indirect costs (Scenario analysis)  
| Cost-effectiveness measurement: Incremental cost-effectiveness ratio (ICER) |
| Discount | 3.5% discount rates for both costs and outcomes |
3-2. Model Structure

The Markov model will be constructed with five health states: perioperative surgery, surveillance, biochemical recurrence, metastasis, and death. Markov state transition diagram for the current model is shown below:

The probabilities for patients to remain within the same health state or to transition to a different state will be based on literature. Hence, patients cycle through the model either until death or until the end of the model’s timeframe (10 years postoperatively for base case).

3-3. Model inputs

**Clinical Outcomes**: The main clinical outcomes of interest include perioperative complications (severity measured by Clavien level), conversion from minimally invasive surgery to open surgery, and dysfunctional outcomes (sexual, urinary incontinence, bladder neck contracture). Literature search will be performed to identify clinical outcomes data based on the highest available level of evidence (systematic literature review or meta-analyses > RCT > observational studies). In addition, recent data is preferred over old data and studies with all three comparison arms are preferred over those with only two comparison arms. Clinical experts will be consulted to verify validity of the clinical input variables.

**Healthcare resource utilization**: UK local data will be used for input related to healthcare resource utilization (e.g., hospital length of stay) to reflect country specific policy and clinical practice pattern.
Direct Medical Cost: This includes costs for surgical equipment, operational room, hospital stay, and treatments for complications, different dysfunctions, surveillance recurrence and metastasis.

- **Surgical Equipment Cost:** This includes capital system cost, yearly maintenance cost and I&A cost if applicable. ISI listing price will be used to calculate dV cost per procedure. The surgical volume per system per year will be defined based on ISI’s internal system log data and depreciation will be assumed to be 7 years. Equipment cost for laparoscopic and open surgery will be obtained from public data source.

- **Hospitalization cost:** This includes cost for hospital stay and treatment cost for complications. Unit cost per hospital stay is based on the NHS reference cost. Occurrence of complications is assumed to extend hospital length of stay therefore increase the hospital cost, with the assumption that each increase in Clavien level is associated with one more inpatient day (e.g., Clavien 1 increases one more hospital day, Clavien 2 increases two more hospital days).

- **Post-hospitalization cost:** This includes cost to treat different dysfunctions, surveillance, recurrence and metastasis. Health services unit costs will be derived from the NHS reference cost.

**Non-NHS Cost: Indirect** Costs such as work and productivity loss, informal care cost, and patient out-of-pocket cost will be included and UK local data will be used when available.

**Utility (Health related Quality of Life):** Literature search will be performed to identity utility values for different health states. UK local data are preferred.

**Transitional probability:** Literature search will be performed to identify transitional probabilities between different health states based on the highest available level of evidence. Patients are at risk of all-cause mortality based on age and gender specific mortality data reported in the UK.

4. **Analysis**

4-1. Base case analysis

Incremental cost-effectiveness ratio (ICER) will be calculated as ratio of the difference in costs divided by the difference in quality-adjusted life-years (QALYs) and then compared with the willingness-to-pay (WTP) threshold suggested by the UK NICE (£30,000/QALY).

\[
\text{ICER} = \frac{C1 - C0}{E1 - E0}
\]

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The primary analysis will be from the UK NHS perspective which only include direct medical cost. Secondary analysis will be conducted from societal perspective which additionally includes costs such as work and productivity loss, informal care cost, and patient out-of-pocket cost.

4-2. Sensitivity analysis

Deterministic sensitivity analysis will be performed by varying one variable at a time and evaluate how the resulting ICER will be changed. The analyses will be repeated for all input variables to understand the uncertainties associated with the parameters of the model and identify the parameters which have the greatest influence on the results. A tornado diagram will be drawn by ranking the most influential variables at the top and visualize the impacts from different input variables.

Probabilistic sensitivity analysis (PSA) will be conducted using 10,000 iterations of Monte Carlo simulations by sampling each parameter simultaneously from their distributions. The PSA results will be presented in a cost-effectiveness plane that shows the proportions the results that are considered cost effective with £30,000/QALY as WTP threshold. In addition, cost-effectiveness acceptability curve will be generated to show that probabilities that different surgical approaches will be cost-effective at different WTP thresholds.

4-3. Scenario analysis

Scenario analysis will be performed to test how the cost effectiveness results will be changed under different assumptions. This may include to consider different surgical volume per system, pricings for different generation of robotic systems, and additional analysis based on the sensitivity analysis results or other clinically meaningful scenarios suggested by clinicians.

5. Limitations

Multiple assumptions are made for the present model:

- All the surgeries are assumed to be performed by surgeon who have passed their learning curve.
- RAS capital cost is assumed to be equally distributed to all the operations performed in each system.
• Converted-to-open cases have the same clinical outcomes as ORP, and conversion is assumed to be happened in the middle of surgery.

• Durations of impact of dysfunction outcomes are assumed as bladder neck contracture for 6 months, urinary incontinence for 1 year, and of sexual dysfunction 2 for years, based on clinical expert’s input. After that, occurrence of those dysfunction outcomes is assumed to have no impact on QALY, which is similar to assumptions made in other studies.

The study will focus on surgical treatment options for local prostatectomy, while other non-surgical treatments will not be considered as comparison arm in the current study.

The current study is designed from the UK NHS perspective. Given the high heterogeneity of healthcare systems and clinical practice, the results might not be directly generalizable to other countries, however the current model is possible to be adapted to other healthcare systems.

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Appendix

TABLE SHELLS

Table 1. Clinical and resource utilization parameters.

| Variables               | (a) Robotic |          |          | (b) Open |          |          | (c) Laparoscopy |          |
|-------------------------|-------------|----------|----------|----------|----------|----------|-----------------|----------|
|                         | Value       | Range    | distribution | Value   | Range    | distribution | Value       | Range    | distribution |
| Operating room          |             |          |           |          |          |           |                 |          |           |
| Conversion rate         |             |          |           |          |          |           |                 |          |           |
| Length of Stay          |             |          |           |          |          |           |                 |          |           |

Table 2 Utility

| Utilities               | Base case | Lower-bound | Upper-bound | Distribution | Source |
|-------------------------|-----------|-------------|-------------|---------------|--------|
| Progression-free utility|           |             |             |               |        |
| Biochemical recurrence utility |       |             |             |               |        |
| Localized recurrence utility |     |             |             |               |        |
| Distant metastasis utility |       |             |             |               |        |
| Disfunction utility     |           |             |             |               |        |

Table 3 Cost Parameter

| Parameter               | Base case | Lower-bound | Upper-bound | Distribution | Source |
|-------------------------|-----------|-------------|-------------|---------------|--------|
| Surgical cost           |           |             |             |               |        |
| Hospitalization cost    |           |             |             |               |        |
| Surveillance cost       |           |             |             |               |        |
| Recurrence cost         |           |             |             |               |        |
| ...                     |           |             |             |               |        |

Table 4 Cost-effectiveness
| Parameter | Cost | Incremental cost | Effectiveness | Incremental Effectiveness | ICER |
|-----------|------|------------------|---------------|---------------------------|------|
| RARP      |      |                  |               |                           | Ref  |
| LARP      |      |                  |               |                           |      |
| ORP       |      |                  |               |                           |      |