Institution: University of Aberdeen

Unit of Assessment: UoA2: Public Health, Health Services and Primary Care

Title of case study: Aberdeen research transforms national policy on the use of robots in prostate surgery

Period when the underpinning research was undertaken: March 2010-May 2011 (published 2012-2013)

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Craig Ramsay	Chair, Director of Health Services Research Unit	1995 – present
James N'Dow	Chair in Surgery (Clin)	2001 – present
Clare Robertson	Research Fellow	2001 – present
Cynthia Fraser	Information Officer	1990 – 2018
Tara Gurung	Research Assistant	2009 – 2011
David Jenkinson	Research Fellow	2007 – 2011
Graham Mowatt	Senior Research Fellow	1995 – 2013
Pawana Sharma	Research Fellow	2008 – 2016
Xeuli Jia	Research Fellow	2006 – 2010

Period when the claimed impact occurred: 2014 and ongoing

Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact (indicative maximum 100 words)

Robotic assisted surgery can improve patient outcomes and change the way that surgical services are delivered. An Aberdeen led project undertook a novel economic modelling assessment to determine the relative clinical- and cost-effectiveness of robotic removal of the prostate compared with standard removal in the treatment of men with localised prostate cancer. The study demonstrated that robotic removal had lower complications with probable improvement in longer term outcomes; and that the large cost of the robot could be offset by maintaining a high case volume for each robotic system. The findings directly informed the funding of robotic surgery in Scotland; national and international guidelines; and the Clinical Commissioning of robots in England, Wales and Northern Ireland. The number of surgical robots increased from 10 to 55 in the UK, resulting in over GBP60 million of sales to the company provider, and transforming surgical services for prostatectomies across the UK. This led to **better informed public policy-making and improved public services** and **improved patient care** for 9000 patients with prostate cancer every year since 2014 and has catalysed the expansion of robotic services in Scotland to other clinical indications.

2. Underpinning research (indicative maximum 500 words)

Prostate cancer is the most common cancer in men. Every year in the UK more than 47,500 men are diagnosed with prostate cancer and 11,500 die. Around 400,000 men are living with and after prostate cancer. When men are diagnosed with cancer of the prostate they have different treatment options depending on the severity of disease. One option is complete removal of the prostate, known as radical prostatectomy, which approximately 7000 men in the UK undergo each year. There are three standard surgical techniques for removal:

1) ***open surgery*** - the surgeon makes a single large cut in the lower abdomen to reach the prostate;

2) ***keyhole (laparoscopic) surgery by hand*** - the surgeon makes five or six small cuts in the abdomen and removes the prostate using special surgical tools;

3) ***robotic-assisted keyhole surgery*** – the surgeon uses similar tools as for keyhole surgery by

hand, but they control the tools from a console in the operating room via four or five robotic arms. Although it is called 'robot-assisted', it is still a surgeon who does the operation (See Figure).

Keyhole surgery by hand appeared to offer the potential for better patient outcomes because it is less invasive than open surgery and the clinical and patient outcomes were at least comparable. In 2010, open surgery and keyhole surgery by hand were the standard care recommended by the National Institute for Health and Care Excellence (NICE) in the UK. Findings from existing research studies carried out to assess the place of robotic-assisted prostate removal in routine care were not conclusive. Some surgical studies demonstrated that robotic-assisted prostate removal might offer improved patient outcomes, such as better removal of all the cancer, whilst others did not show benefits. In addition, given a robot is a large capital investment, each costing around £1.5 million, it was not clear whether potential benefits outweighed the costs. In 2010, there were only 10 robots in the UK, all purchased by charities.

To help the NHS decide whether patients would benefit (and where it was cost effective to introduce this new technology) our Aberdeen-led research group undertook a novel synthesis of the global evidence of studies that had compared robotic-assisted prostate removal with other techniques. Some 57 studies were included, involving 19,064 patients from 15 countries. The evaluation also applied a comprehensive health economic assessment which incorporated highly specialised economic modelling techniques to inform the research. It included an assessment of whether increasing the number of surgical procedures performed per year in a surgical centre improved outcomes and costs. The research was conducted between March 2010 and May 2011 and published 2012-2013 [**R1**; **R2**; **R3**].

The results showed that outcomes were better for robotic-assisted removal than for laparoscopic surgery; for example for major adverse events such as blood transfusion (decrease of 30%) and organ injury rates (decrease of 4%), in addition to failure rates for cancer removal (decrease of 31%). Furthermore, the study indicated that the large cost of the robot would be offset if it was used at high volumes of at least 150 procedures per year.

3. References to the research (indicative maximum of six references)

The research outputs (Google Scholar **citations** shown) *and research grant award underwent rigorous independent external peer review:*

R1. Close A, **Robertson C**, Rushton S, Shirley M, Vale L, **Ramsay C**, Pickard R. Comparative cost-effectiveness of robotic prostatectomy and laparoscopic prostatectomy as alternatives to open radical prostatectomy for the treatment of men with localized prostate cancer: A Health Technology Assessment from the Perspective of the UK National Health Service. Eur Urol 2013; **64**:361-9. doi: 10.1016/j.eururo.2013.02.040. (**97**)

R2. Ramsay C, Pickard R, **Robertson C**, Close A, Vale L, Armstrong N, Barocas D, Eden C, **Fraser C**, **Gurung T**, **Jenkinson D**, **Jia X**, **Lam T**, **Mowatt G**, Neal D, Robinson M, Royle J, Rushton S, **Sharma P**, Shirley M, Soomro N. Systematic review and economic modelling of the relative clinical benefit and cost-effectiveness of laparoscopic surgery and robotic surgery for removal of the prostate in men with localized prostate cancer. Health Technol Assess 2012; **16**:1-313. doi: 10.3310/hta16410. (**178**)

R3. Robertson C, Close A, **Fraser C**, **Gurung T**, **Jia X**, **Sharma P**, Vale L, **Ramsay C**, Pickard R. Relative effectiveness of robotic-assisted and standard laparoscopic prostatectomy as alternatives to open radical prostatectomy for treatment of localised prostate cancer: a

systematic review and mixed treatment comparison meta-analysis. British Journal of Urology International 2013; **112**:798-812. doi: 10.1111/bju.12247. (**86**)

All papers above were the key research dissemination papers on effectiveness and cost-effectiveness of the use of robotic-assisted prostate removal in the UK.

Key grant funding associated with the research

The project was conducted by a UK National Institute for Health Research (NIHR) Health Technology Assessment programme grant led by Craig Ramsay (HSRU, University of Aberdeen). Title: *Systematic review and economic modelling of the relative clinical benefit and cost-effectiveness of laparoscopic surgery and robotic surgery for removal of the prostate in men with localised prostate cancer. NIHR HTA programme,* March 2010 to May 2011, GBP158,729. Sponsor: University of Aberdeen.

4. Details of the impact (indicative maximum 750 words)

The findings directly informed the funding of robotic surgery in Scotland; national and international guidelines; the Clinical Commissioning of robots in England, Wales and Northern Ireland and underpinned expansion of robot use to other procedures. The study led to **better informed public policy-making and improved public services** and **improved patient care** for 9000 patients with prostate cancer every year since 2014 and has informed the expansion of robotic services in Scotland to other clinical indications. Details of the impacts and how they were achieved are given below.

A. Scottish Government funds the introduction of robots

In light of our project findings, the Cabinet Secretary for Health and Wellbeing of the Scottish Government requested in 2012 that a national planning review to assess whether robotic surgery for prostate cancer should be introduced into NHS Scotland [**S1**]. This was undertaken by Healthcare Improvement Scotland who used our report as one of the primary pieces of evidence [**S2**]. The impact of this review was that in August 2014, the Scottish Government announced an investment of GBP1 million towards the purchase of a robot in Aberdeen; followed by another GBP2 million in March 2015 to two NHS Boards for the purchase of two more robots for east and west of Scotland [**S3**; **S4**]. The first robotic prostatectomy in Scotland was undertaken in Aberdeen in August 2015 and this service is now fully operational with over 1000 procedures performed so far [**S5**]. A Consultant Urological Surgeon outlined the benefits of the service as shortening patient recovery time; reducing complications such as incontinence; reducing training time for surgeons; and reducing physical demand on surgeons undertaking operations of several hours [**S5**]. The two additional robots at Queen Elizabeth University Hospital in Glasgow and NHS Lothian for the provision of radical prostatectomy became fully operational by 2018 [**S6**].

B. Aberdeen's study findings used as a recommendation in NICE Clinical Guidance on the management of prostate cancer

Following the Scottish review, NICE in England then launched a review as to whether robot-assisted surgery should be permissible in the English NHS. The NICE national guidance, published in January 2014, makes extensive use of and explicitly references the Aberdeen systematic review results and economic analyses on a number of occasions [**S7**]. They also concluded on the basis of the evidence, including the extensive modelling we had undertaken that:

"Recommendation 1.3.15

Commissioners of urology services should consider providing robotic surgery to treat localised prostate cancer

Recommendation 1.3.16

Commissioners should base robotic systems for the surgical treatment of localised prostate cancer in centres that are expected to perform at least 150 robot-assisted laparoscopic radical prostatectomies per year to ensure they are cost effective." (this was a direct use of the

Aberdeen modelling results)

C. Commissioners of new robots in NHS England use our recommendations

The NICE decision precipitated NHS England to review its national policy and in 2015, NHS England implemented a national policy to improve access to robotic–assisted prostate removal for patients with localised prostate cancer [**S8**]. The commissioning report explicitly references the NICE prostate cancer guidance recommendations as informing the NHS England policy. The report concludes on page 15 that:

"RAS [robot assisted surgery] procedures will be offered as a choice alongside existing commissioned procedures (open and laparoscopic) to all patients with localised prostate cancer, where this is determined to be clinically appropriate, by specialist Multi-Disciplinary Teams (MDTs).

*RAS procedures will be commissioned from networked centres performing high volumes (i.e.150 robotic assisted laparoscopic radical prostatectomies) in line with the evidence relating to volume and outcome." a*gain explicitly using the Aberdeen modelling conclusions.

Several Clinical Commissioning Groups refer to this recommendation in commissioning decisions [**S9**].

D. Improving people's health and their access to robotic services

The decisions made by the Scottish and English NHS authorities outlined above directly authorised the widespread use of robot assisted surgery in the UK NHS. Prior to our research, about 25% (approximately 1500) of patients annually had their prostates removed by robot-assistance in 2010. At that time, there were only around 10 robots in the UK health system, primarily in large research centres like Oxford and London. Following the NHS decisions, robot-assisted systems started to be bought for the NHS. By 2019, seven years after our report, the National Prostate Cancer Audit report [**S10**] (page 25) from the Royal College of Surgeons of England demonstrated the number of robotic-assisted prostatectomies increasing annually to 89% of cases now removed by robot-assistance. This has been achieved by increasing to 55 surgical robots being used for surgical removal of the prostate across the country, resulting in over GBP60 million of sales to the company providers. This six-fold increase in robots available directly benefits up to 9000 patients per year who now undergo surgical removal of the prostate with a reduced need for blood transfusions, fewer infections and reduced injuries to internal organs. After our research, robot-assisted prostate removal is now the dominant surgical method in the UK.

E. Informing the spread and use of robotic surgery into other clinical areas in the UK

Once centres established their robotic skills in radical prostatectomy, this then allowed centres to train other local clinicians in robotic skills – enabling managed expansion into the robotic provision of other clinical procedures and clinical areas (building on the solid foundation given through the radical prostatectomy services). As such, the original Aberdeen modelling which underpinned the introduction of robotic systems into the NHS has now allowed the skills and experience learnt to be cascaded to transform services in other areas. Recent reports suggest that robot-assisted procedures in the UK have now been expanded to other urological procedures such as partial nephrectomy, cystectomy and to other clinical specialties including colorectal and thoracic surgery.

Expansion to other services is predicated on a strong robot-assisted procedure foundation at sites (earned through the original provision of urological services). To demonstrate this, our Robotic study Chief investigator [Ramsay] is a member of Healthcare Improvement Scotland Evidence Review Committee (Scotland's National Committee for producing guidance on new technologies) and was invited to provide expert advice from the robotics project findings to inform the potential expanded use of the existing robots in Scotland. In January 2018 guidance was produced recommending use of the following robotic techniques: Robot-assisted surgery compared with laparoscopic resection for the treatment of rectal cancer; Transoral robotic surgery for the diagnosis of head and neck cancer of unknown primary Transoral robotic surgery for

oropharyngeal and supraglottic laryngeal cancers; Robot assisted laparoscopic partial nephrectomy in patients with T1a or T1b renal cancer [**S11**]. The guidance states that:

"*Provision of robot-assisted surgery [for rectal cancer] should be concentrated within centres that currently have a robotic surgical device and are likely to receive a sufficient number of suitable patients per year to maintain surgeon proficiency.*"

In December 2020, NHS Grampian announced the GBP5.7million expansion of their robotic programme with the purchase of 3 new robotic machines. One robot will increase the urology treatments available to patients, another is planned for use in knee and hip replacement operations while the third would be used in general surgery, thereby expanding the clinical benefits to many more patients than currently available [**S12**].

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1. Minutes of National Planning Forum 11th December 2012. Scottish Government; 2013

S2. Radical prostatectomy for localised prostate cancer: Evidence Note 49. Health Improvement Scotland; May 2013.URL: http://www.healthcareimprovementscotland.org/our_work/technologies_and_medicines/earlier_evidence_notes/evidence_note_49.aspx (accessed September 20160.

S3. Transforming surgical care: NHS patients to get pioneering robotically assisted surgery Scottish Government press release. Scottish Government Communications, August 2014 URL: http://news.scotland.gov.uk/News/Transforming-surgical-care-ffd.aspx (accessed September 2016)

S4. Further investment in pioneering surgical careL: NHS patients to benefit from robotically assisted surgery. Scottish Government Communications, March 2015 URL: http://news.scotland.gov.uk/News/Further-investment-in-pioneering-surgical-care-173c.aspx (accessed September 2016)

S5. Consultant Urology Surgeon ARI Testimonial Letter

S6. Shona Robinson: S4W-28345. Written Daily Answers, Scottish Parliament, 19 November 2015.URL: http://www.parliament.scot/S4_ChamberDesk/WA20151119.pdf (accessed September 2016)

S7. Prostate cancer: diagnosis and management. NICE Clinical Guideline CG175.London; National Institute for Health and Care Excellence, January 2014. URL: https://www.nice.org.uk/guidance/cg175 (accessed September 2016).

S8. Clinical Commissioning Policy: Robotic-Assisted Surgical Procedures for Prostate Cancer. NHS England, July 2015.URL: https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2015/10/b14pa-rbtic-asstd-srgry-prostate-cancer-oct15.pdf (accessed September 2016)

S9. Robotic surgery at STH. Executive summary report to the board of directors held on 17th July 2013. Sheffield Teaching Hospitals NHS Foundation Trust, 2013. URL: http://www.sth.nhs.uk/clientfiles/File/Enclosure%20L%20-%20Trust%20Board%20_Public_%20Robot.pdf (accessed September 2016)

S10. National Prostate Cancer Audit. URL: https://www.npca.org.uk/content/uploads/2021/01/NPCA-Annual-Report-2020_Final_140121.pdf

S11. Scottish Health Technologies Group. Advice Statements, January 2018. URL: http://www.healthcareimprovementscotland.org/our_work/technologies_and_medicines/shtg/health_technologies_assessed.aspx

S12. Press article: https://www.pressandjournal.co.uk/fp/news/aberdeen/2711089/robotic-assisted-surgery-aberdeen/