Board Meeting
3 12 20
Open Session
Item 6

APPENDICES

BUSINESS CASE FOR THE DEVELOPMENT OF ROBOTIC ASSISTED SURGERY

DIVISION OF SURGERY

NHS GRAMPIAN ACUTE SECTOR

November 2020

(DRAFT)

Table of Contents

Appendix 1

Extract From National Framework for RAS Regarding Actions

Local Board Actions	Regional Actions	National Actions
• Expansion of RAS in Surgical Groupings		
• Boards with existing RAS systems should create a local RAS Strategic Group to lead exploration of current usage and scope to introduce new areas of surgeon within current RAS capacity • Board with existing RAS systems should agree an action timeline to introduce the new areas	• Regional Cancer Networks should work with host RAS system tertiary boards to explore best usage of systems and key areas for improvements.	• The national oversight group and national clinical reference group (CRG) for RAS should work with local and regional to support the introduction of new areas within current and future RAS systems to work towards the stretch aims set.
• Workforce – Training & Establishment		
• Should undertake a Training needs analysis in line with local expansion plan	• Should work with local boards in region to agree wave of surgeon train against regional and local priorities and national framework	• The national oversight group and CRG would work with Royal Colleges and RAS providers to explore Scotland based training centers for RAS, linked to Universities etc. to enable undergrads to come out with the start of RAS skills as core, alongside Deanery CCT training
• Coding, Datasets & Stretch Aims		
• Boards should work with the national group on coding improvements and reporting on stretch aims		• The national oversight group and CRG should agree stretch aims for RAS areas e.g. 85% of all colorectal surgery should be MIS RAS by 2025 (could explore similar data to BAUS – see sample in Appendix 7) • The national oversight group should lead work with ISD and the national theatres group to improve coding processes
• Innovation & Evidence		
• Boards should support evidence by evaluation and enables NHSS to be more proactive and timely in its adoption of major disruptive technology	• Regions should support evidence by evaluation and enables NHSS to be more proactive and timely in its adoption of major disruptive technology • Regional Innovation Hubs should consider their scope within the RAS arena	• The national oversight group and CRG should explore a system within NHSS that supports evidence by evaluation and enables NHSS to be more proactive and timely in its adoption of major disruptive technology
• Finance & Procurement		
• Board to work collegiately with the national group for once of Scotland approach	• Regional to support the national group	• The national oversight group should work with SG health finance, DoFs and NHSS Procurement to explore a sustainable national system for funding, procurement and rolling programme.

Appendix 2

Benefits Realised from 2015 Business Case

The table below summarises the anticipated benefits, along with the actual benefits realised as set out in the Robotic Business Case initially focussing on urology pathways which was approved by the Grampian NHS Board in 2015.

PATIENT BENEFITS	ACTUAL BENEFIT REALISED/EVIDENCE
Safer, quicker and more effective surgery	No increase in number of sphincters implanted despite doubling number of cases. No increase in complications compared with laparoscopic approach.
Reduction in Adverse Events	Overall reduction in complications.
Reduced surgical related trauma	Reduced in patient stay and opiate usage. No use of caudals
Reduce blood loss	Blood loss was reduced - average blood loss reduced from 325 to 220 mls. Larger saving in cystectomy and nephrectomy patients.
Reduction in pain	Reduced pain and inpatient stay.
Reduce risk of infection	Reduced use of antibiotics.
PATIENT RECOVERY BENEFITS	
Lower perioperative morbidity	Reduced number of sphincters and erectile dysfunction medications, reduced numbers of secondary interventions (bladder neck incisions)
Shorter recovery time, reducing patient stay in hospital	Inpatient stay was reduced from 48 hours to 24 hours.
A quicker return to normal daily activities	Reduced need for post-surgery adaptations Decline in average pad usage
STAFF BENEFITS	
Attracts surgical staff	Additional prostaectomists - single surgeon until 2014. Now, 3 fully trained surgeons within 3 months.
Decreased surgical learning curve	Training is shorter. 6 month learning on the robot versus 2.5 years for regular surgery
Decreased surgical fatigue	More operations per surgeon per day
Reduction of surgeon hand tremors	No information received.
SERVICE BENEFITS	
Greater volume of cases	Case load increased 158 prostatectomies in 2019 versus 71 in 2014
More complex procedures can be performed	Partial nephrectomies can be completed, preventing dialysis and morbidity of renal failure Cystectomy and hysterectomy patients who were unfit for conventional surgery can now be operated on.
Clinically superior results	Oncological outcomes superior to laparoscopic (reduction in positive surgical margins) therefore less need for secondary interventions ie radiotherapy

Appendix 3

ROBOTIC ASSISTED ARTHROPLASTY - EVIDENCE BASE

PARTIAL KNEE ARTHROPLASTY

Whilst the full impact of robotics within knee surgery is not yet fully understood, there are early indications for partial knee replacement (PKR) that use of robotic technology will ultimately reduce revision rates, a further improvement for patients and reduce costs. The increased ability to replicate and standardise clinical outcomes using robotics addresses the challenges of ensuring precision associated with a manual PKA approach, improving clinical outcomes for the patient and facilitating greater use of the more minimally invasive PKA procedure.

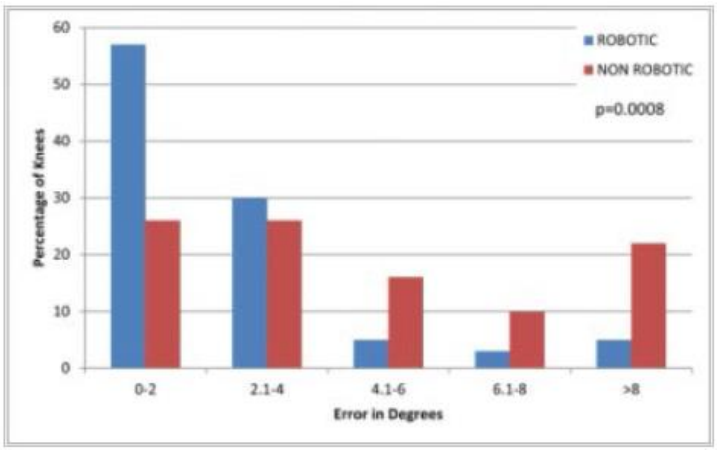
In a large multicenter retrospective study [ref: Pearle AD, van der List JP, Lee L et al. Survivorship and patient satisfaction of robotic-assisted medial unicompartmental knee arthroplasty at a minimum two-year follow-up. Knee 2017 Mar; 24(2):419-428.] (n=797 patients; 909 knees), Mako robotic-arm assisted PKA procedures had a cumulative revision rate of 1.2% at two years, with 92% of patients either satisfied or very satisfied. This compares favourably with the two-year revision rates of 'conventional' (i.e. non-robotic assisted) PKA published in the Swedish and Australian registries (4.5% and 4.8% respectively). The UK registry for manual PKA outcomes is still in development.

During partial knee arthroplasty (PKA) the surgeon replaces only the damaged portion of the knee with an implant, conserving the patient's own knee ligaments and unaffected cartilage. In preserving more of the patient's healthy knee tissue and bone, PKA is less invasive and offers benefits in terms of better range of motion and knee function, less blood loss during surgery and a shorter recovery time.Prospective, single centre, level 1, randomised controlled trial (RCT) demonstrated that robotic PKA patients experienced significantly lower post-operative pain compared to manual patients from day one until week eight:

(Jones et al, 2013)

Bell et al's (2016) Level 1 randomised control trial demonstrated that there was greater accuracy against the pre-operative surgical plan in alignment measurements at month three for patients undergoing Mako as opposed to manual PKA.

Accuracy of Component Positioning in PKR – robotics vs. non-robotics

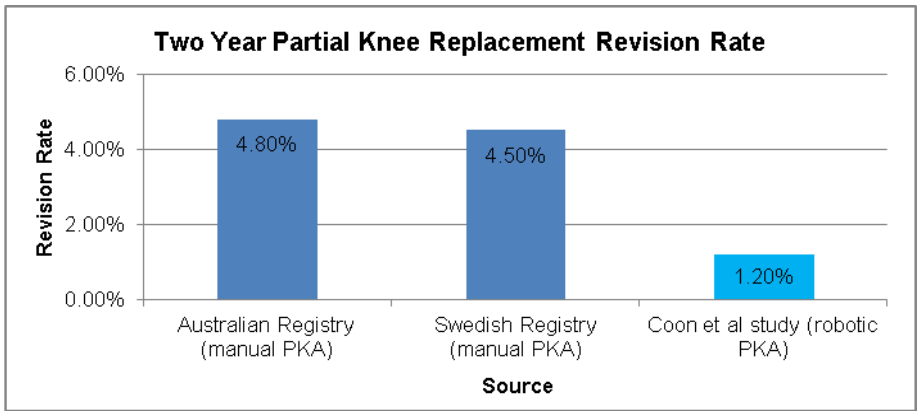


(Bell et al, 2016)

A further study from the same investigators showed that robotic partial knee arthroplasty using Mako achieved statistically significant kinematic differences over manual PKA, with a gait pattern that was not significantly different from normal controls (i.e. no knee surgery), unlike manual PKA patients who had a noticeably altered gait post-operatively.

In a large multicenter retrospective study (n=797 patients; 909 knees), Mako robotic-arm assisted PKA procedures had a cumulative revision rate of 1.2% at two years. The UK registry for manual PKA outcomes is still in development; however, registries in Sweden and Australia are well established giving a baseline for comparison. As shown in the chart below, the revision rate for robotic PKA is almost 75% lower than that seen in manual cases.

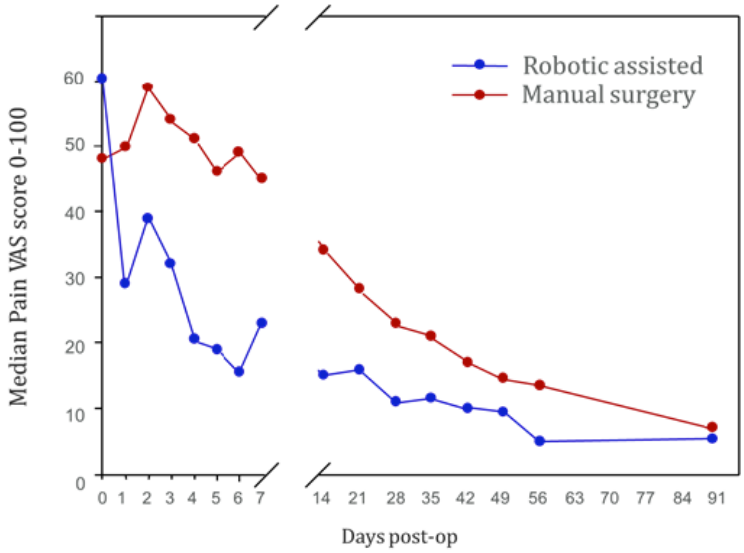
PKA Revision Rate



(AOANJRR, 2015; Swedish Knee Arthroplasty Register, 2015; Coon et al, 2015)

Similarly, a prospective, single centre, level 1, randomised controlled trial (RCT) demonstrated that robotic PKA patients experienced significantly lower post-operative pain compared to manual patients from day one until week eight:

Visual Analog Pain Score (VAS) for Partial Knee Replacement

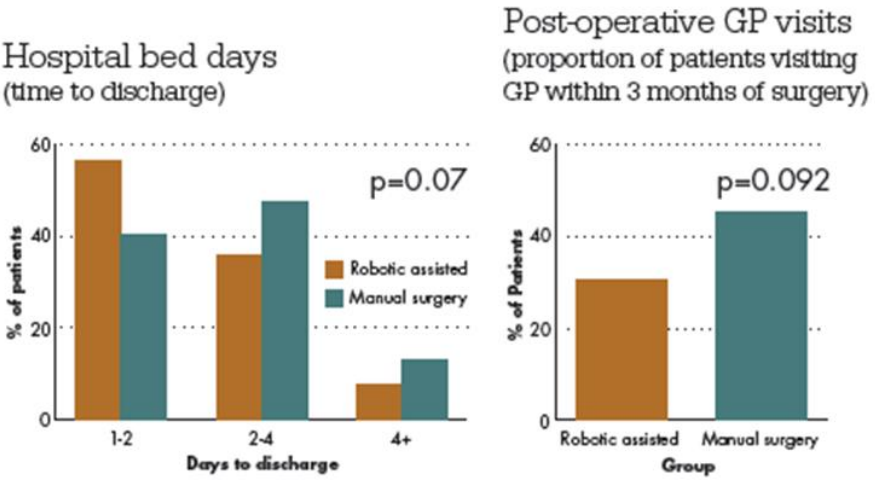


(Jones et al, 2013)

The implications of this for patients are that access to robotic assisted PKA has the potential to improve patient outcomes and experience when compared with a manual approach through facilitating greater access to a minimally invasive procedure. In increasing the accuracy robotic PKA also reduces complications resulting in revision surgery, reduces post-operative pain, and facilitates earlier return to activity.

In a Scottish study, Blyth et al (2013) demonstrated that PKA undertaken using robotics offered efficiencies. As shown in the charts below, visits to general practitioners and hospitalisations within 3 months of surgery were lower for Mako Robotic-Arm Assisted PKA patients (office visits: 30% vs. 45%; hospitalisations: 3% vs. 8%). Use of Mako PKA procedures also translated into 54 bed-days saved per 100 patients.

Resource usage – Mako robotic system vs. manual procedures



(Blyth et al, 2013)

The implications of this for patients are that access to robotic assisted PKA has the potential to improve patient outcomes and experience when compared with a manual approach through facilitating greater access to a minimally invasive procedure. In increasing the accuracy robotic PKA also reduces complications resulting in revision surgery, reduces post-operative pain, and facilitates earlier return to activity.

Other relevant studies include:-

Cool C, Needham K, Coppolecchia A, Khlopas A, Mont M. Revision Analysis of Robotic-Arm Assisted and Manual Unicompartmental Knee Arthroplasty. J Arthroplasty. 2019 May;34(5):926-931

Abstract Conclusions: The study results demonstrate that patients who underwent rUKA had fewer revision procedures, shorter length of stay, and incurred lower mean costs (although not statistically different) during the index admission and at 24 months postoperatively. These results could be important for payers as the prevalence of end-stage knee osteoarthritis increases alongside the demand for cost-efficient treatments.

Link to Full Publication:
https://www.researchgate.net/publication/330462459_Revision_Analysis_of_Robotic-Arm_Assisted_and_Manual_Unicompartmental_Knee_Arthroplasty

Dretakis K, Igoumenou V**. Outcomes of robotic-arm-assisted medial unicompartmental knee arthroplasty: minimum 3-year follow-up**. Eur J Orthop Surg Traumatol. 2019 Mar 26

Abstract Conclusions: In conclusion, robotic-arm-assisted UKA, through accurate implant positioning, significantly improves range of motion and coronal plane alignment, in appropriately selected patients. Excellent overall satisfaction rates and clinical outcomes can be expected, at intermediate follow-up, along with excellent survival of implants and minimal to none surgery-related morbidity.

Link to Full Publication: https://www.springermedizin.de/outcomes-of-robotic-arm-assisted-medial-unicompartmental-knee-ar/16576950

Kayani B, Konan S, Tahmassebi J, Rowan, F. Haddad F . **An assessment of early functional rehabilitation and hospital discharge in conventional versus robotic-arm assisted unicompartmental knee arthroplasty**. Bone Joint J 2019;101-B:24–33. (Jan 2019)

Abstract Conclusions: Robotic-arm assisted UKA was associated with decreased postoperative pain, reduced opiate analgesia requirements, improved early functional rehabilitation, and shorter time to hospital discharge compared with conventional jig-based UKA.

Link to Full Publication: https://online.boneandjoint.org.uk/doi/abs/10.1302/0301-620X.101B1.BJJ-2018-0564.R2

F. Catani, F. Zambianchi, A. Marcovigi, G. Franceschi, R. Nardacchione **COMPONENT POSITIONING AND SOFT-TISSUE TENSIONING INFLUENCE CLINICAL OUTCOMES OF ROBOTIC-ASSISTED MEDIAL UNICOMPARTMENTAL KNEE ARTHROPLASTY: A SHORT-TERM FOLLOW-UP STUDY** BJJ Orthopaedic Proceedings. Vol. 100-B, No. SUPP_12 (Oct 2018)

Abstract Conclusion: In the present study, survivorship and clinical outcomes of a large cohort of 309 patients with medial robotic assisted UKA were contacted with at a mean 3-years. The overall survivorship was found to be 99%, with tibial component failure as the most common reason for UKA revision. The significant difference between pre- and post-operative clinical scores highlights the efficacy of robotic assisted UKA in restoring knee function and relieving pain. Differences in components' positioning and soft-tissue tensioning demonstrated significant correlation with post-operative clinical outcomes.

Link to Full Publication: https://online.boneandjoint.org.uk/doi/abs/10.1302/1358-992X.2018.12.003

Millar L.J., Banger M., Rowe P., Blyth M., Jones B., Maclean A. **A five-year follow up of gait in robotic assisted vs conventional unicompartmental knee arthroplasty** Gait & Posture (Sept 2018),

Abstract: Recently, systems have been developed to improve alignment of unicompartmental knee arthroplasty (UKA) implants, although improvement in function has been difficult to document. The MAKO RIO robotic surgery system has previously shown improvements in in knee flexion during weight acceptance (WA) in comparison to conventional methods at a one year follow up. This study aimed to determine if these improvements remained at five years follow up. Twenty five MAKO and 21 conventional knees were tested using three dimensional gait analysis to measure knee kinematics. Results demonstrated that the MAKO group achieved significantly greater knee flexion in

WA than the conventional group which was consistent with results are one year. This could be due to the improved accuracy of prosthesis implantation offered by the MAKO system.

Link to Full Publication:
https://www.sciencedirect.com/science/article/abs/pii/S0966636218307628?via%3Dihub

P. G. Robinson, N. D. Clement, D. Hamilton, M. J. G. Blyth, F. S. Haddad, J. T. Patton **A systematic review of robotic-assisted unicompartmental knee arthroplasty: prosthesis design and type should be reported.** Bone Joint J 2019;101-B:838–847

Abstract Conclusion: There is little description of the choice of implant when reporting robotic-assisted UKA, which is essential when assessing survivorship, in the literature. Implant positioning with robotic-assisted UKA is more accurate and more reproducible than that performed manually and may offer better functional outcomes, but whether this translates into improved implant survival in the mid- to longer-term remains to be seen.

Link to Full Publication: https://online.boneandjoint.org.uk/doi/abs/10.1302/0301-620X.101B7.BJJ-2018-1317.R1?journalCode=bjj

TOTAL KNEE ARTHROPLASTY

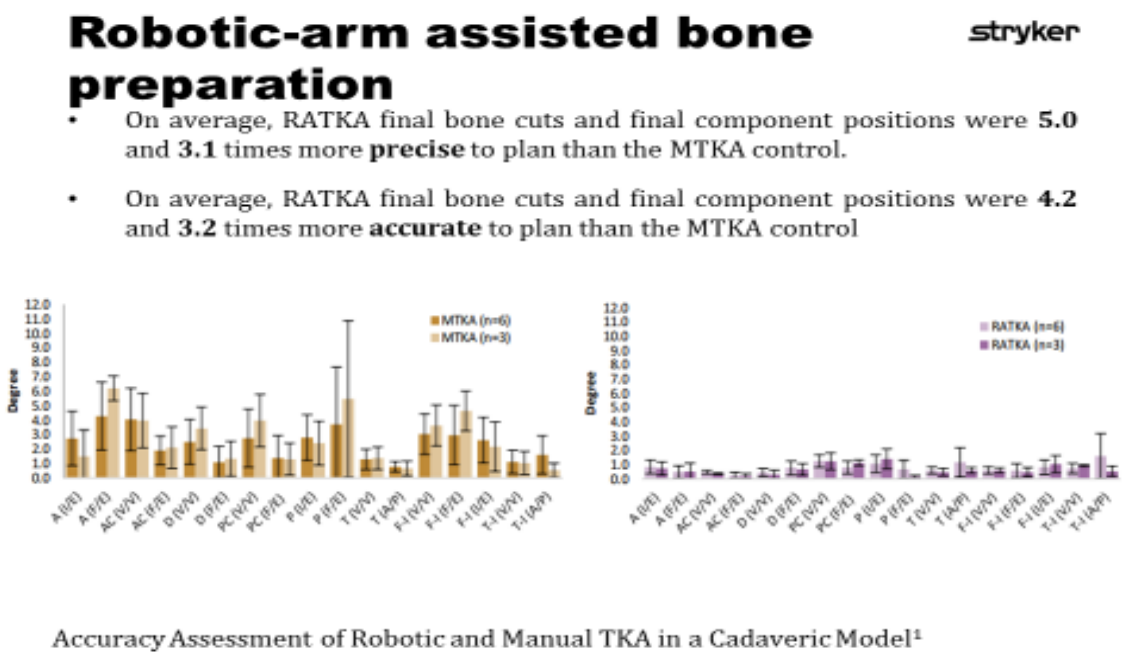
Robotic –arm assisted total knee arthroplasty demonstrates greater accuracy compared to manual techniques minimising the current expected degree of error, less than 3 degrees.

Robotics also reduces soft tissue damage and smaller incision, less pain etc, supports lower LOS.

Robotics allows smaller incision, less pain, but also tissue-sparing which may allow better function and quicker recovery. Due to improved kinematics (“the way the joint moves”) the joint replacement “feels” better and may allow accelerated recovery. The robot allows other procedures that are essentially very difficult without robotic assistance, e.g. bicompartmental PKA, which is combined medial and patellofemoral arthroplasty.

In the long term more accurate alignment and ligament balance should mean better function, higher return to work rate and few follow ups visits etc (including GP time), also lower wear, lower complications (e.g.) dislocation means improved implant longevity and lower revision rates.

Robotic-arm assisted total knee arthroplasty demonstrated greater accuracy to plan compared to manual techniques. E Hampp, I. Sholl, M Prieto,T. Chang et al.



Accuracy Assessment of Robotic and Manual TKA in a Cadaveric Model[1]

Greater precision and accuracy is reference in the table above leading to improved outcome.

In the long term more accurate alignment and ligament balance should mean better function, fewer follow up visits, and most significantly lower wear rates with a consequent reduction in revision rates for loosening and osteolysis (bone loss), which is the commonest reason for revision. A landmark study from the Australian Joint registry

de Steiger RN, Liu YL, Graves SE. Computer navigation for total knee arthroplasty reduces revision rate for patients less than sixty-five years of age.] showed that computer-assisted knee arthroplasty using navigation led to a significantly reduced overall revision rate at 9 years compared to non-navigated knee arthroplasty (4.6% vs. 5.2%), with a particular benefit seen in the higher demand group of patients under sixty-five years of age (6.3% vs. 7.8%).

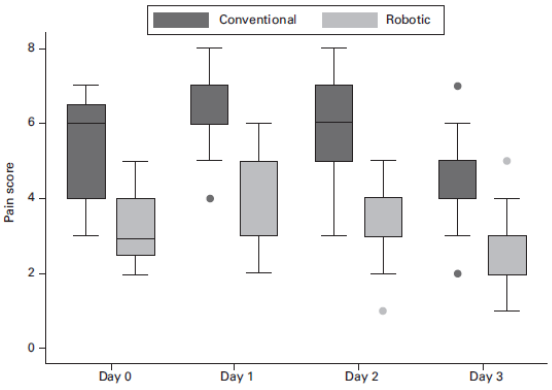
J Bone Joint Surg Am 2015 Apr;97(8):635-42

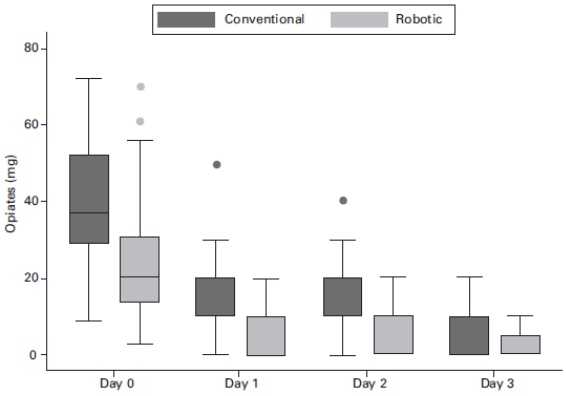
Robotic-arm assisted total knee arthroplasty is associated with improved early functional recovery and reduced time to hospital discharge compared with conventional jig-based total knee arthroplasty

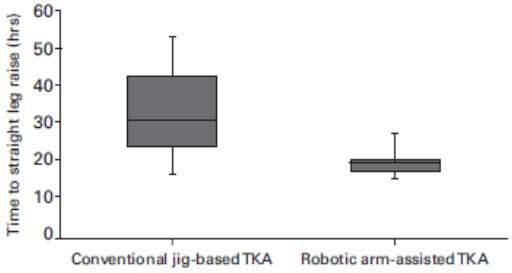
Bone Joint J (2018) 100-B: 930-7.

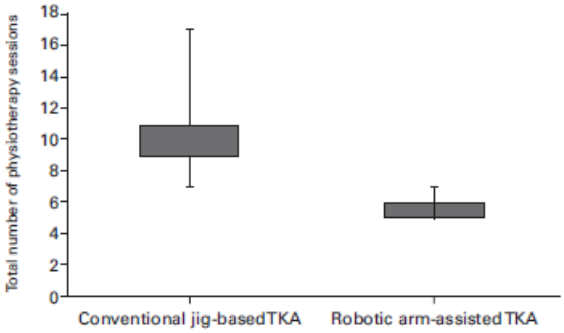
The study compared 40 consecutive ‘manual’ TKR (mTKR) with 40 consecutive robotic-arm assisted (rTKR) using Mako. Robotic TKR had statistically significant reduced post-op pain, decreased analgesia requirements, decreased post-op Hb drop, shorter time to straight leg raise, decreased number of PT sessions, and improved maximum knee flexion at discharge. Median time to hospital discharge with 77hours for rTKR vs 105 hours (mTKR).

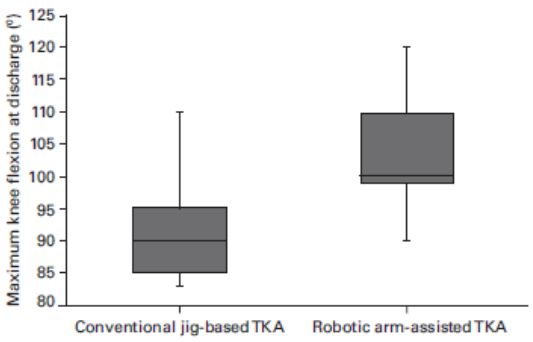
Outcome	Conventional (n = 40)	Robotic (n = 40)	p-value
Mean operating time (mins)	61.2 (54.6 to 83.1)	70.4 (59.2 to 91.7)	0.34*
Mean fall in Hb (g/L)	26.1 (5.1 to 49.6)	18.7 (8.0 to 37.2)	< 0.001*
Mean postoperative Hb (g/L)	106.7 (77.3 to 138.4)	114.7 (86.4 to 139.1)	0.01*
Mean pain score (NRS) – Day 0	5.4 (3.0 to 7.0)	3.1 (2.0 to 5.0)	< 0.001*
Mean pain score (NRS) – Day 1	6.3 (4.0 to 8.0)	3.6 (2.0 to 6.0)	< 0.001*
Mean pain score (NRS) – Day 2	6.1 (3.0 to 8.0)	3.3 (1.0 to 5.0)	< 0.001*
Mean pain score (NRS) – Day 3	4.5 (2.0 to 7.0)	2.6 (1.0 to 5.0)	< 0.001*
Median analgesia (mg) – Day 0	36.0 (IQR 29.0 to 51.3)	20.0 (IQR 16.0 to 28.5)	< 0.001†
Median analgesia (mg) – Day 1	10.0 (IQR 10.0 to 20.0)	10.0 (IQR 0.0 to 10.0)	< 0.001†
Median analgesia (mg) – Day 2	10.0 (IQR 10.0 to 20.0)	10.0 (IQR 0.0 to 10.0)	< 0.001†
Median analgesia (mg) – Day 3	10.0 (IQR 0.0 to 10.0)	0.0 (IQR 0.0 to 5.0)	< 0.001†
Median time to SLR (hrs)	31.0 (IQR 24.0 to 44.0)	20.0 (IQR 18.0 to 21.0)	< 0.001†
Median knee extension (°)	0.0 (IQR 0.0 to 0.0)	0.0 (IQR 0.0 to 0.0)	0.08†
Mean knee flexion (°)	93.3 (90.0 to 110.0)	104.1 (90.0 to 120.0)	< 0.001*
Median physiotherapy sessions (n)	11.0 (IQR 9.0 to 11.0)	5.0 (IQR 5.0 to 6.0)	< 0.001†
CPM sessions, n (%)	5 (*12.5*)	2 (*5.0*)	0.43‡
Median time to discharge (hrs)	105.0 (IQR 98.0 to 126.0)	77.0 (IQR 74.0 to 81.0)	< 0.001†

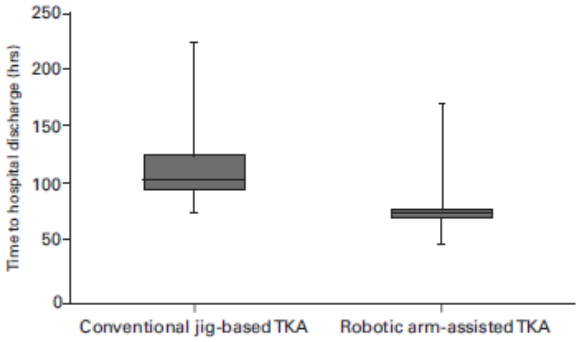












Other relevant studies include :-

Marchand R, Sodhi N, Anis H, Ehiorobo J, Newman J, Taylor K, Condrey C, Heptinstall M, Mont M. **One-Year Patient Outcomes for Robotic-Arm-Assisted versus Manual Total Knee Arthroplasty**. J. Knee Surg. Apr 2019.

Abstract Conclusion: The RAA technique was found to have the strongest association with improved scores when compared with age, gender, and BMI. This study suggests that RAA patients may have short-term improvements at minimum 1-year postoperatively. However, longer term follow-up with greater sample sizes is needed to further validate these results.

Link to Full Publication: https://www.ncbi.nlm.nih.gov/pubmed/30959549

Kayani B., Konan S., Pietrziek J., Haddad F. S**. Iatrogenic Bone and Soft Tissue Trauma in Robotic-Arm Assisted Total Knee Arthroplasty Compared With Conventional Jig-Based Total Knee Arthroplasty**. The Journal of Arthroplasty 2018.03.042

Abstract Conclusion: There is reduced bone and periarticular soft tissue injury in patients undergoing RA-TKA compared to CJ-TKA. The proposed MASTI classification system is a reproducible grading scheme for describing iatrogenic bone and soft tissue injury in TKA.

Link to Full Publication: https://www.ncbi.nlm.nih.gov/pubmed/29699827

Kayani, B., Konan, S., Tahmassebi, J., Pietrzak, J., Haddad, F. S. **Robotic-arm assisted total knee arthroplasty is associated with improved early functional recovery and reduced time to hospital discharge compared with conventional jig-based total knee arthroplasty**. Bone and Joint Journal: 2018; 100-B:930–7.

Abstract Conclusion: Robotic-arm assisted TKA was associated with decreased pain, improved early functional recovery and reduced time to hospital discharge compared with conventional jig-based TKA

Link to Full Publication: https://www.ncbi.nlm.nih.gov/pubmed/29954217

Cool, C., Needham, K., Mont, M., Jacofsky, D. **A 90 Day Episode of Care Cost Analysis of Robotic Assisted Total Knee Arthroplasty.** J Comp Eff Res. 2019 Apr;8(5):327-336.

Abstract Conclusion: rTKA incurred an overall lower 90-day EOC cost versus mTKA. Savings were driven by fewer readmissions and an economically beneficial discharge destinations.

Link to Full Publication: https://www.ncbi.nlm.nih.gov/pubmed/30686022

TOTAL HIP ARTHROPLASTY

Primary hip arthroplasty forms a significant part of the orthopaedic caseload. The benefits offered by robotics for this procedure therefore have the potential to make a tangible difference to the Orthopaedic service.

A study by Domb et al (2014) radiographically analysed fifty Mako THRs and 50 manual THRs undertaken by a single surgeon to assess how accurately the cup implant had been placed. As illustrated in Diagram B, 100% of robotic assisted cases were placed within the Lewinnek 'safe zone' and 92% fell within the Callahan 'Safe Zone. This compares with 80% of manual cases within the Lewinnek 'safe zone' and 62% within the Callahan 'Safe Zone'. It is also of note that the robotics cases demonstrated less variability in their outcomes shown in the tighter cluster within the 'safe zone'.

Accuracy of cup placement in robotic vs. manual THR

Diagram A – Manual THR

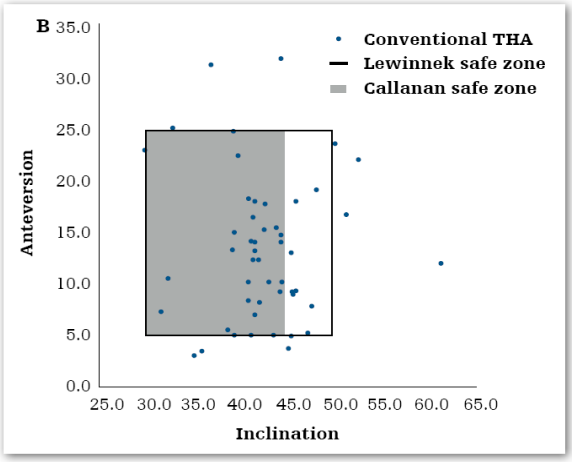
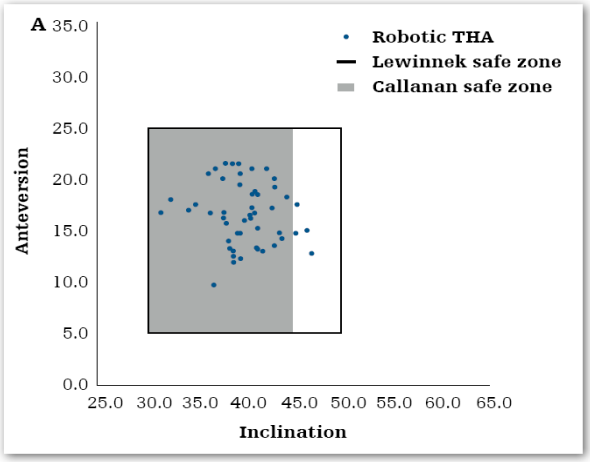


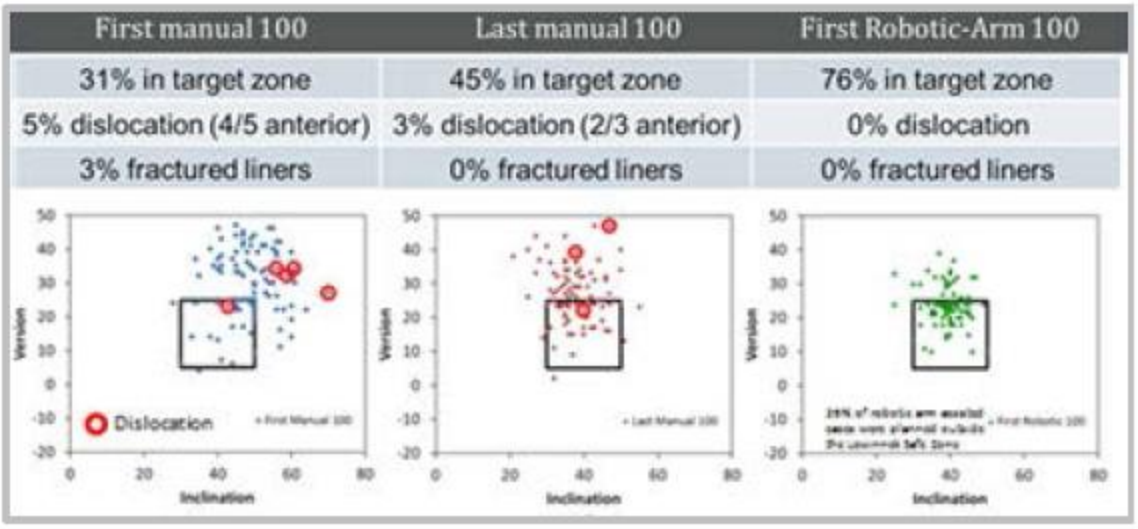
Diagram B – Robotic Assisted THR



Domb et al, 2014

Illgen (2013; 2014) compared outcomes from a surgeon's first one hundred consecutive cases and last one hundred consecutive cases using a manual approach against the same surgeon's first one hundred robotic cases. As shown in the diagram below, from first use a robotic approach delivers greater consistency in outcomes, and a more precise match with the surgical plan than a manual approach with a reduction in complications such as dislocation and fractured liners. It is also of note that the robotic cases which fell out with the target area were not due to error, rather they were deliberate adjustments to the plan on the basis of clinical judgment due to anatomical needs (such as pelvic tilt) of individual patients.

Surgical outcomes robotic vs. manual THR



(Illgen, 2013; Illgen 2014)

The improved accuracy entailed in robotics has the potential to offer direct benefit to Jubilee patients. The more accurate alignment and ligament balance afforded by robotics results in better function joint function with lower wear and lower complications such as dislocation which improve the implant's longevity and decrease the likelihood of revision. This in turn reduces the need for follow up hospital and GP visits, and results in a higher return to work rate.

Other relevant studies include :-

B. Kayani, S. Konan, R. R. Thakrar, S. S. Huq, F. S. Haddad **Assuring the long-term total joint arthroplasty: a triade of variables.** Bone Joint J 2019;101-B (1 Supple A):11–8. (Jan 2019)

Abstract Conclusion: Robotic-arm assisted THA was associated with improved accuracy in restoring the native centre of rotation, better preservation of the combined offset, and more precise acetabular component positioning within the safe zones of inclination and anteversion compared with conventional manual THA.

Link to Full Publication: https://online.boneandjoint.org.uk/doi/full/10.1302/0301-620X.101B1.BJJ-2018-0377.R1

Perets, I., Walsh, J., Close, M., Mu, B., Yuen, L., Domb, B. **Robotic-Arm Assisted Total Hip Arthroplasty – Clinical Outcomes and Complication Rate**. Int J Med Robotics Comput Assist Surg. 2018;14:e1912. (Aug 2018)

Abstract Conclusion: Robotic-arm-assisted THA demonstrates favourable short-term outcomes and does not result in a higher complication rate compared to non-robotic THA as reported by the literature.

Link to Full Publication: https://www.ncbi.nlm.nih.gov/pubmed/29761618

REDUCED REVISION RATES

Improved outcomes leads to a longer lifespan of the replacement, therefore a reduced requirement for revision operations. Reduction in revision and reduction in associated cost:

Top reasons of revision or reoperation[1]

From a study of 1100 revised THA from 1986-2005 at a high volume teaching hospital

- **Aseptic loosening (45.3%)**
- **Osteolysis/wear (15.7%)**
- **Instability (15.7%)**
- Infection (10.7%)
- Periprosthetic fracture (5.7%)

"The success of hip arthroplasty is likely to be compromised if technical aspects of the surgery for appropriate component positioning and critical protocols to minimize complications such as infection are not given the proper attention." [2]

Appendix 4

Benefits, Anticipated Impact, Measurements & Alignment to Objectives

Investment Objectives

A. Safe, person-centred and outcome focused care
B. Staff health, wellbeing and safety
C. Improved effectiveness and efficient care
D. Tackling inequalities
E. Workforce sustainability and development

Ref No	Benefit	Anticipated Impact Once Service is Fully Established	Method of Measurement	Alignment to Investment Objectives
1.	Reduction in complications	Lower risk with fewer complications and adverse events	Number of complications recorded	A, C
2.	Less likelihood of surgeon error	Safer surgery and higher confidence in surgical process	Number of errors recorded	A, C
3.	Reduced likelihood of fat embolism (orthopaedic surgery) and blood loss	Fewer negative impacts from surgery, leading to quicker recovery time and reduced length of stay	Average volume of blood loss measured Number of incidents of embolism	A, C
4.	Reduced pain after surgery	Better patient experience and quicker recovery	Patient experience surveys, monitoring patient recovery	A
5.	Reduced risk of infection	Low levels of infections, leading to quicker recovery time and reduced antibiotic use	Infection rates measured	A
6.	Shorter recovery time	Quicker return to regular daily activities/work	Length of time until normal daily activities can resume	A, C
7.	Preservation of function	Patients to retain more functionality as a result of the	Number of adaptations required by patients	A

Ref No	Benefit	Anticipated Impact Once Service is Fully Established	Method of Measurement	Alignment to Investment Objectives
		procedure, resulting in fewer adaptations required post-operation, reduced post-op care, improved/maintained quality of life	Quality of life survey/PROMS	
8.	Reduced length of stay	Patients can get home quicker, and more beds available for other services	Number of bed days used after surgery/length of stay	C
9.	Reduced utilisation of critical care beds	More available bed capacity for the most unwell patients. Greater organisational resilience and reduced cancelled elective care operations due to critical care access	Critical care utilisation/bed days for each service Number of cancelled elective care operations due to unavailability of critical care bed	C, A
10.	Fewer follow up visits and post-op community care	Fewer GP, community and clinic follow ups are required, freeing staff time to see more patients and improving access for other patients	% of patients who require appointments post-operation	A, C, D
11.	Widens the scope of potential patients able to undergo surgery. Those who are unable to have regular surgery will be able to have robotic surgery	Better outcomes for patients who previously were not able to access surgery	% of population who requires surgery is able to undergo robotic surgery	A, D
12.	Higher volume of cases can be undertaken	Waiting times will be improved and a higher percentage of the population requiring surgery will be able to access it quickly	Volume of cases measured Waiting times reduction	A, C, D

Ref No	Benefit	Anticipated Impact Once Service is Fully Established	Method of Measurement	Alignment to Investment Objectives
13.	Lower revision rates for uni-compartmental knee replacements	Frees up surgeon's time to take on new cases and less time spent on replacements and corrections	Number of revisions measured	A, C
14.	Recruitment and Retention	Full complement of staff can be achieved, allowing for adequate staffing on shifts and appropriate cover to allow staff breaks and leave time	Staff satisfaction through iMatter, staff turnaround, vacancies measured	B, E
15.	Research Opportunities	Increased opportunities for research and collaboration with academic partners. Reputational. Attracting staff who want to work in innovative healthcare system.	Number of active research projects Funding grants Recruitment and retention data	E
16.	Training opportunities	Support the establishment of NHS Grampian in collaboration with academic partners as a training centre of excellence for national and international courses	Training courses offered/uptake Fellowships	E
17.	Shorter learning curve	Less time required to train required number of surgeons	Length of training period Number of surgeons trained vs required	C, E
18.	Larger surgeon cohort able to offer MIS	More surgeons can utilise minimally invasive procedures via robotic surgery to create sustainable and resilient service delivery.	Number of cases undertaken via robotic surgery Appropriate volume of cases per surgeon	A, C, E
19.	Reduction in repetitive strain injury /occupational injuries	Higher quality of work environment for surgeons	Staff surveys, occupational health referrals, time off work due to injury	B

Ref No	Benefit	Anticipated Impact Once Service is Fully Established	Method of Measurement	Alignment to Investment Objectives
		Reduced injuries and reduced sickness absence.		
20.	Reputation	Establish NHS Grampian as a Centre of Excellence for Robotic Surgery, Training and Research	Visits/requests from other centres for support/guidance Recruitment/Retention of Staff Training uptake/Fellows	E

Appendix 5

Case for MAKO Robot for Orthopaedic Surgery

Background

Osteoarthritis is the commonest form of arthritis in the UK and causes joints to become painful and stiff. In 2015 the Scottish Burdon of Disease Study estimated that osteoarthritis affects > 450,000 individuals in Scotland, resulting in 16,600 Disability-Adjusted Life Years. The exact cause of osteoarthritis is not known, so prevention strategies tend to be ineffective in reducing the burden of this disease on society. It most commonly affects the hips, knees and small joints of the hands. Although weight loss, regular exercise and walking aids can mitigate the effects of osteoarthritis, it is a long-term condition and cannot be cured.

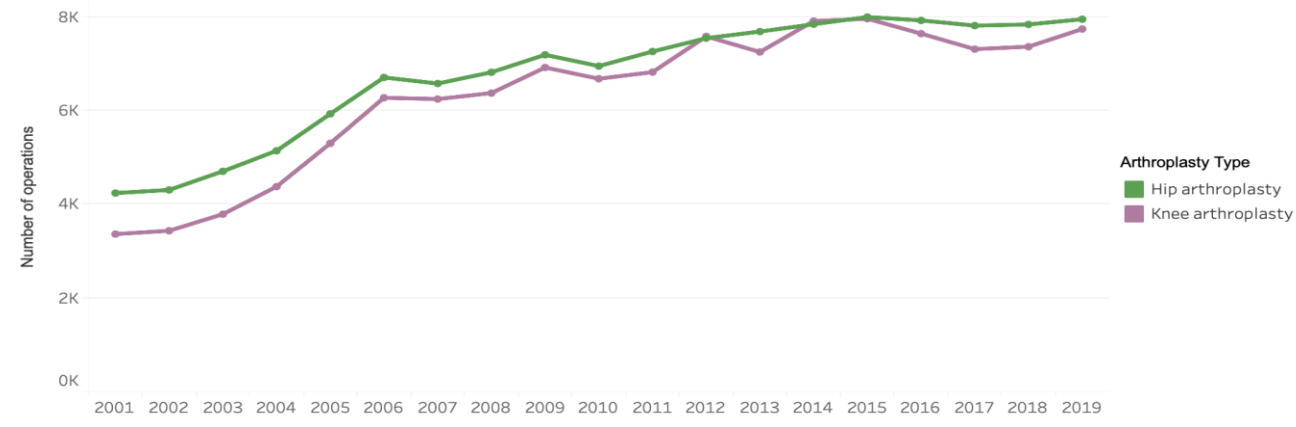
For weight-bearing joints, particularly the hip and knee joints, end-stage treatment of osteoarthritis usually involves joint replacement surgery (arthroplasty). With successful health improvement strategies resulting in increased life expectancy, the number of hip and knee arthroplasties undertaken each year in Scotland has increased over the last few decades. More recently this has plateaued, potentially reflecting a limit on access to joint replacement surgery, rather than a flattening of demand. This is likely the case within Grampian, where challenges around recruitment and retention of staff, compounded more recently by the coronavirus pandemic, have restricted access to elective operating within orthopaedics at Woodend Hospital. As a result, the orthopaedic in-patient waiting list has steadily increased, with > 1,100 patients currently waiting for hip and knee replacement surgery out of a total waiting list of >2,800 patients. This translates to >1 year on the in-patient waiting list.

Activity - Primary Procedures

Public Health Scotland

Figure 1a shows the number of primary hip and knee arthroplasties performed across Scotland. The number of hip procedures performed remains relatively static over the last few years.

Figure 1a: Primary hip and knee arthroplasty procedures per year (2001 - 2019)



Note: Includes emergency admissions; bilateral operations counted twice; includes known patients from independent hospitals

Figure 2a: Number of Knee arthroplasty, All, by Health Board of Treatment

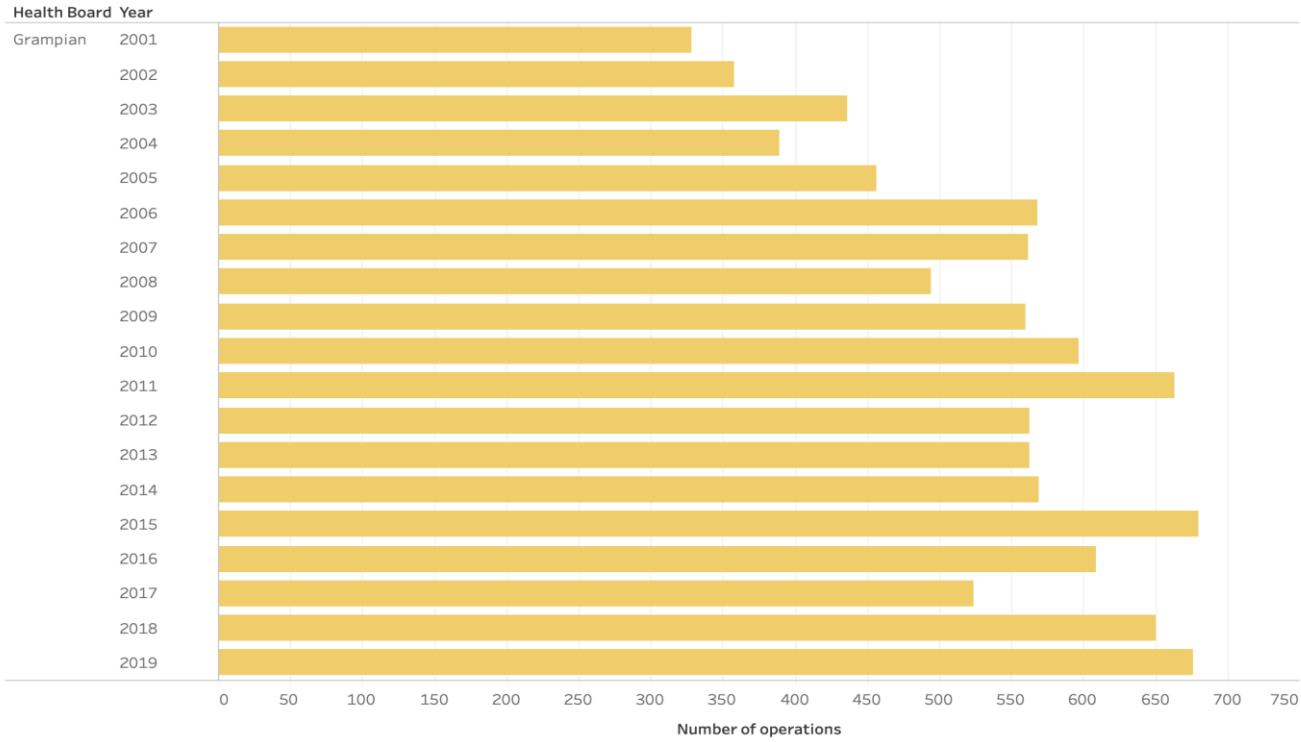
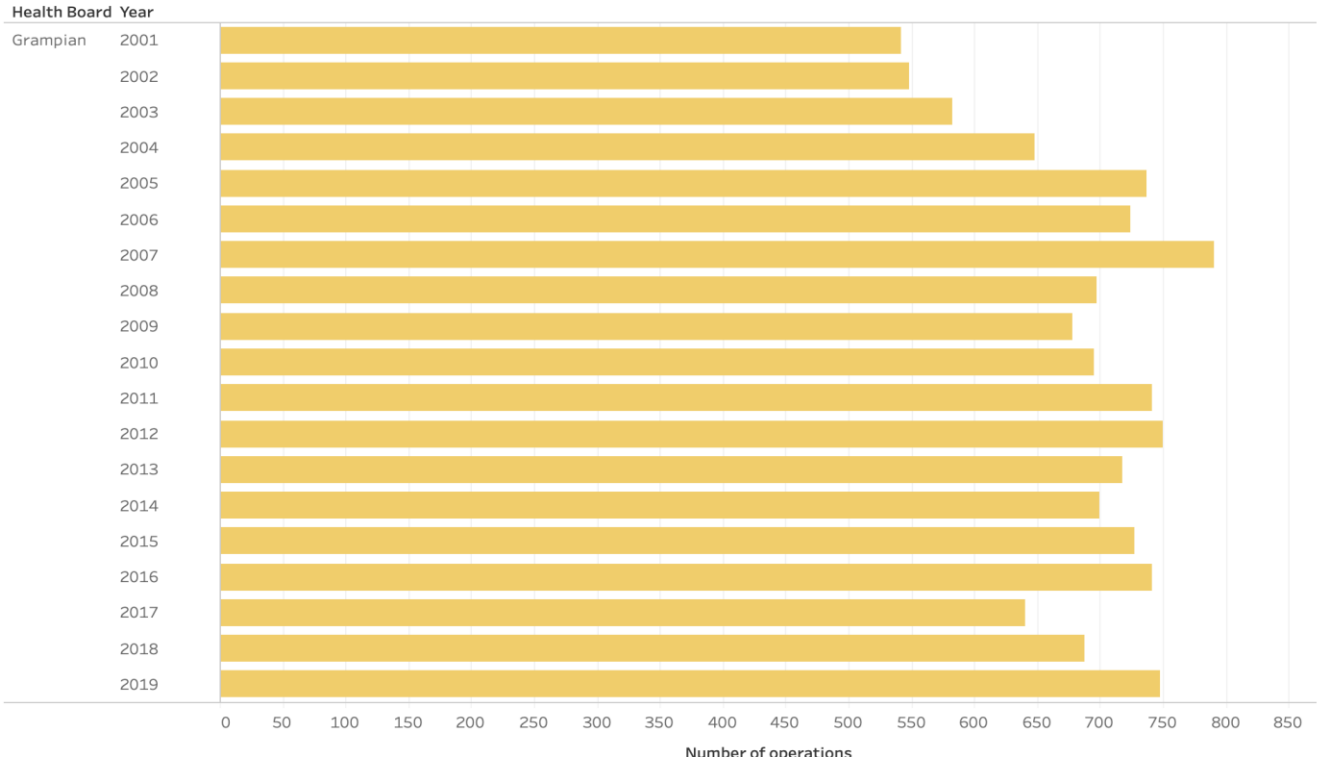
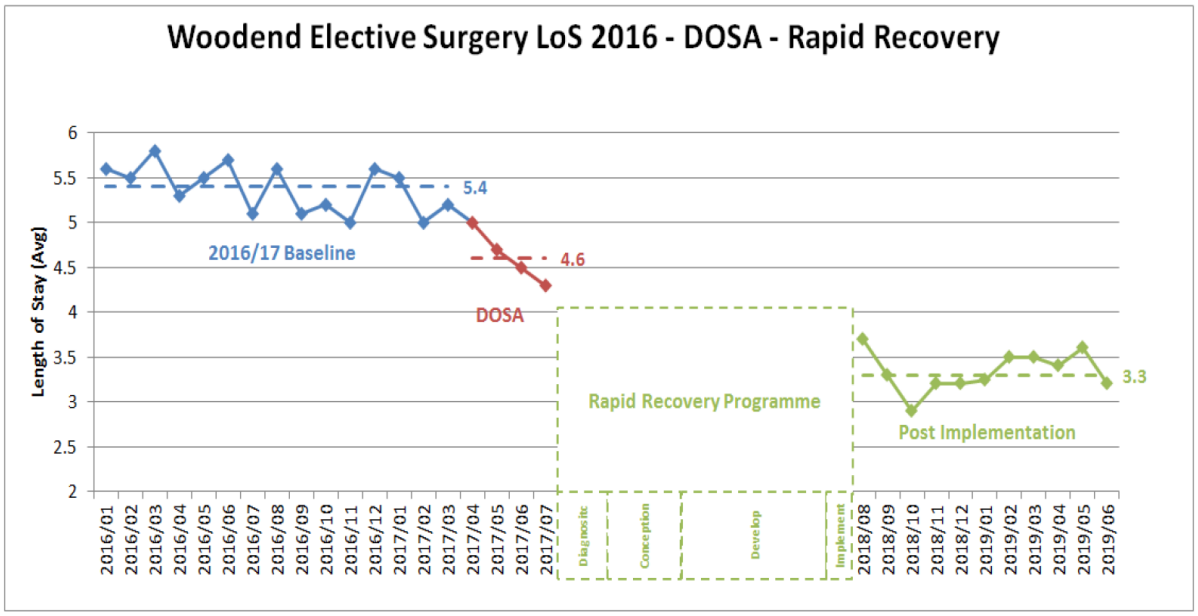


Figure 2a: Number of Hip arthroplasty, All, by Health Board of Treatment



Length of Stay

The Orthopaedic Department has undertaken multiple improvement projects in the last few years to improve in-patient care, safety and satisfaction. Although not the primary focus, one of the consequences of Day of Surgery Admission (DOSA) and implementation of Enhanced Recovery After Surgery (ERAS, Rapid Recovery) is a decrease in patient length of stay (LoS). Our success has been recognised nationally, with provision of Scottish Government funding to continue ERAS and requests to share our initiatives with other Health Boards in Scotland. Between 2017 and 2019 we moved from the bottom quartile to the top quartile for length of stay within Scotland.



By June 2019, the

- Percentage of patients with a length of stay of 3 days or less increased from 17% to 70%
- Woodend Hospital was in the top quartile for % of patients with LoS of 3 days or less and was the best non-Specialist hospital in Scotland
- 46% increase in throughput (321 patients) with no increase in staffing or bed capacity was achieved, with an annual saving of 1,058 bed days

These figures remained stable until March 2020. While LoS has remained static, bed capacity at Woodend as a result of the coronavirus pandemic has reduced from 66 to 28 beds. We have tried to mitigate this dramatic loss by focussing on improvement initiatives which can further reduce LoS and thereby enable more patients to be treated with less resource in a safe and effective manner. The three main areas of focus are:

1. **Maximising the efficiency of ERAS.** Progress made by NHS Fife, particularly around pain management, has resulted in some patients being discharged within 24 hours of hip or knee arthroplasty surgery. Learning from other boards and optimising our current procedures is likely to result in a small but

measurable improvement in LoS. We have been successful in our application for Scottish Government funding to continue our ERAS program into 2021.

2. **Novel surgical approach to the hip joint.** The 'anterior approach' to the hip enables access to the joint with less muscle and soft tissue damage than other more traditional approaches. This results in less pain, quicker recovery and a shorter LoS. This approach has not been favoured in the past as the view of the hip joint is more restricted, resulting in a longer and more technically demanding operation. There is a higher risk of malalignment of the hip implants, so x-rays require to be taken during surgery, requiring the presence of a radiographer and resulting in radiation exposure to staff. We have surgeons at Woodend trained in this approach and they have demonstrated, with careful patient selection, that discharge within 24 hours can be achieved. The use of a Mako robot would increase the number of patients suitable for this approach, and decrease risk by:
    - Enabling precise alignment of hip implants, even in more obese patients where visual inspection of the joint is more challenging
    - Eliminating the need for intra-operative x-rays, stopping radiation exposure to staff
    - Reduce the risk of intra-operative fracture by precise sizing and positioning of the hip implants.

3. **Use of the Mako robot.** The Mako robot has been shown to reduce post-operative pain compared to traditional hip and knee surgery, probably as a consequence of less soft-tissue dissection being required during surgery. As a result, patient LoS is reduced. The precision afforded by the robot provides more confidence in widening the indications for undertaking a partial knee replacement in patients where total knee replacement may otherwise be considered. As recovery from a partial knee replacement is shorter than a total knee replacement, this would also result in decreased LoS. A summary of projected reduction in LoS is shown below during the implementation phase of the Mako robot. Once fully implemented, we would expect 375 bed days to be freed up per year, enabling an extra 120-150 joint replacements (or equivalent) to be undertaken per year with the same ward staffing resource. This would enable us to return to four joint replacements per list, instead of the current three, with the same theatre staffing resource. While this is more modest compared to the >1,000 bed days/yr we have already freed up since 2017, it is nonetheless significant.

	Number of Robotic Cases per week*		Bed days freed up per week
	Per day	Per week	
Month 1	1 Joint	5 Joints	2.5 days
Months 2 & 3	2 Joints	10 Joints	5 Days
Month 4	3 Joints	15 Joints	7.5 days

*The maximum of 3 joints per day from month 4 takes into account time allocated to the robot for 1 tumour case per month and ongoing training of consultants and trainees.

Skills Gained

Use of the Mako robot will result in surgeons not yet trained acquiring additional skills during their careers. The robot will not entirely replace any particular procedure, so it is not anticipated that any skills will be lost.

- Novel surgical approaches, such as the anterior approach to the hip, are likely to be undertaken more frequently. For trainees this is a directly transferrable skill in the surgical management of septic arthritis of the hip in infants. Undertaking this approach in an elective environment will provide safe training for when it is needed in an emergency setting.
- Improved assessment of soft tissue tensioning and alignment during knee replacement surgery. The Mako robot provides real-time feedback of knee alignment and positioning during surgery. This enables surgeons to improve their hand-eye coordination skills over time, which in turn improves their accuracy when undertaking non-robotic, manual orthopaedic cases.

Tumour Surgery

While orthopaedic tumours are thankfully rare, primary and metastatic tumours in the long bones and the pelvis can be challenging to manage, particularly with regards to working out appropriate bony resection margins. Based on data from 2019, we would anticipate that approximately one tumour case per month would be suitable for robotic intervention, providing a more precise tumour resection margin and likely reducing the length of the surgical procedure.

Outcome Measurement

The following combination of outcome measures will be used to assess the impact of the robot:

- Patient-reported outcome measures (PROMs): pre- and post-operative patient scores will be collected to provide specific (Oxford Hip/Knee) and generic (EQ-5D-3L) scoring which can be directly compared with non-robotic surgery. No extra resource is needed for this as it is already part of routine practice within the department, with appropriate funding in place.
- Scottish Arthroplasty Project annual reporting: all NHS Grampian hip and knee surgeons give permission for their outcome data to be collected and compared at a national level. This enables direct comparison between Boards of surgical activity, patient length of stay and complications such as infections and hip dislocations. We expect that following implementation, patients undergoing robotic surgery will have a decreased length of stay of approximately 0.5days/patient, patients undergoing hip replacement will have a decreased hip dislocation rate and the readmission rate for robotically-treated patients within 90 days will decrease. We expect that NHS Grampian will remain in the top quartile for length of stay, despite improvements being made in other Boards that we have already implemented. Over time (several years) we would

anticipate a decrease in revision surgery for both hip and knee replacement patients that have been treated robotically.

- The Mako robotic system stores data of every procedure undertaken. Therefore, retrospective analysis can be undertaken to investigate cohorts of patients with particularly good outcomes (or complications) to ensure ongoing quality improvement.

Summary of Benefits of Mako Robot

- Reduced post-operative pain
- Reduced risk of fat embolus (for total knee arthroplasty)
- Reduced length of in-patient hospital stay – natural evolution of our journey since 2017 to improve patient experience and reduce length of stay
- Shorter recovery at home
- Earlier return to work for those of working age (~45% of patients), reducing burden of osteoarthritis to society as a whole
- Increased chance of being suitable for partial knee replacement (for those with knee osteoarthritis), with associated higher patient satisfaction
- Approximately 375 bed days/year freed up to treat other orthopaedic patients
- Improved staff recruitment and retention with early adoption of new technology – only one other Health Board in Scotland has Mako robot (GJNH). Our geographical isolation makes this critical in encouraging surgical fellows and other colleagues to work in Grampian.
- Significant research opportunities
- Four orthopaedic consultants are already trained in the use of the Mako robot and use it in routine private practice. A fifth consultant is being trained in November 2020. Learning curve for department is therefore minimised.
- Reduced number of cases needing early revision, resulting in less patient morbidity and cost-savings to NHS Grampian. Even a modest reduction in revision cases of 1 – 2 per year due to anticipated decreased hip dislocation rates would result in cost savings of approximately £30,000 - £50,000.

Appendix 6

Benefits & Case of Robotic Assisted Surgery in General Surgery

The main benefits from the introduction of Robotic Assisted surgery in the General Surgery service are positive patient experience, less post-operative pain, shorter length of stay, higher rate of function preservation and potentially lower rate of post-operative complications. These benefits are explained in more detail below and within the draft General Surgery Business Case.

Patient safety/experience

- The smaller incisions and greater precision entailed in robotic surgery results in a reduced complication rate and less likelihood of surgeon error.
- Reduced likelihood of surgical related trauma and blood loss.
- Less pain and reduced risk of infection.
- Smaller incisions can be made than with traditional surgery, resulting in shorter scars which may be more appealing to patients.

Improved clinical outcomes and effectiveness

- Reduced revision rate, reduced pain and risk of infection leading to shorter recovery and reduced length of stay (LOS),
- Earlier return to normal activity following surgery.
- Will gradually improve the scope of the patient population to potentially benefit from curative surgery e.g. the elderly population, patients with relatively higher co-morbidities and the obese patients who may otherwise not be able to sustain a laparotomy for a cancer resection or have unacceptably high post-operative morbidity
- Colorectal: There is a clear subset of colorectal cancer patients with locally advanced +/- low rectal cancer who would benefit from sphincter preservation surgery enabling them to potentially avoid a lifelong stoma as well as improve their disease-free survival through a more precise and comprehensive resection.
- HPB: Historically HPB surgery is associated with a high morbidity and the potential for the laparoscopic approach technically challenging. Hence there has been a slow uptake of this approach. However, its benefits are strikingly clear. This creates scope for improving uptake of the minimally invasive approach through a robotic approach which is a more stable platform with greater surgeon-level control. In our HPB team, all Whipple's procedures and distal pancreatectomies would be potentially suitable for the robotic approach.

At least 60% of the liver resections would benefit as opposed to the current 30% with the laparoscopic rate.

- Upper GI Surgery: All Upper GI oncological resections performed currently are deemed suitable for the robotic approach as opposed to the current low rate of laparoscopic approach due to technical challenges.

- Endocrine: It could be envisaged that robotic adrenal surgery might replace laparoscopic adrenal surgery in the future, and will extend the remits of minimally invasive adrenal surgery by enabling larger tumours to be removed

Improved Patient Efficiency and Productivity

In pursuing a more minimally invasive route by which patients have a smaller incision, less soft tissue damage and consequently less pain, the length of stay for robotic patients is lower.

Reduced serious post-operative morbidity in turn translates into a reduced length of stay and less rehabilitative cost post-operatively.

The implementation of the robotic approach will enable the team to perform a higher number of oncologically complete resections with greater ease and in due course shorter operating time and potentially provide gut continuity and sphincter preservation.

In the long term this will be a cost saving due to improved QALYs from the absence of a permanent stoma. On average, the length of stay for rectal cancers alone could be reduced by a minimum of 2 days.

Recruitment and Retention

Most eminent general surgical units across the UK and internationally use robotic technology and establishing a robotics service for General Surgery and Oncology within Grampian will ensure that the Service remains at the leading edge of clinical developments, offering our patients the best care available and promoting NHS Grampian as a Board who embodies an ethos of innovation and quality. In turn the availability of this contemporary technology within Grampian, will help attract high calibre surgeons, trainees and specialised theatre staff to the North of Scotland.

In addition we would be recognised as early adopters of this technology within NHS Scotland, which will act as a draw to Clinical Fellows and for research. Will help the development of the department into a centre of excellence.

The colorectal team has built a national and international reputation for providing training in advanced laparoscopic colorectal surgery. The team has successfully run one of the few fellowships accredited by Association of Coloproctology of Great Britain

and Ireland in laparoscopic colorectal surgery in the UK. Since 2012, the team has trained 10 fellows and 6 senior trainees, all of them were appointed as consultant colorectal surgeons with specialist interest in laparoscopic surgery. The colorectal group has also produced highly cited publications in laparoscopic and robotic colorectal surgery.

Opportunities for Research

The scale of the Board's general Surgery Service combined with the expertise in clinical research found within the Consultant body mean that the Board should be well placed to lead on future research in this emerging new field.

The proposed robotic team includes members from each general surgical sub-specialty with strong established academic links. The University of Aberdeen has an established team of researchers in Computer Science with a potential for developing a research program into Artificial Intelligence. Aberdeen Royal Infirmary and University of Aberdeen have established academic expertise in Radiology and Nuclear Medicine and links have currently been established to bring these areas of expertise together from a translational perspective to explore the development of novel technologies to improve operative precision and patient related outcomes.

Similarly, strong links exist with the University of Aberdeen's Health Science Research Unit to develop applied clinical research projects. One such project has secured pump priming funding to develop core outcome sets for RAS (RoboCOS study) and is set to complete in January 2021 with a view to applying for CSO funding for father work. Other work currently in the feasibility stage explores surgeon related ergonomics and fatigue and collaborates with the Occupational Health team for this purpose.

The team are also developing proposals along surgical innovation in robotics with the opportunity to apply for pump priming grants in early 2021.

The DaVinci System

At present the only surgical system that offers the, evidence based, consistently high standard of precision operating to support more complex surgery is the Da Vinci surgical system.

The Da Vinci system is a robotic surgical tool, which allows complex surgery to be performed through small incisions. The robot is positioned over the patient's abdomen deploying the telescope and instruments deep inside the patient's abdomen. The surgeon sits at the console, which is situated inside the operating theatre, and is able to view live 3D images of the patient's organs. Using hand and foot controls, the surgeon can manipulate the camera and instruments inside the patient's body to

perform complex tasks that would otherwise have exceeded his/her abilities with conventional laparoscopy and would be associated with an increased morbidity if performed by laparotomy. The Da Vinci system offers the following benefits to the surgeon compared to traditional surgical techniques:-

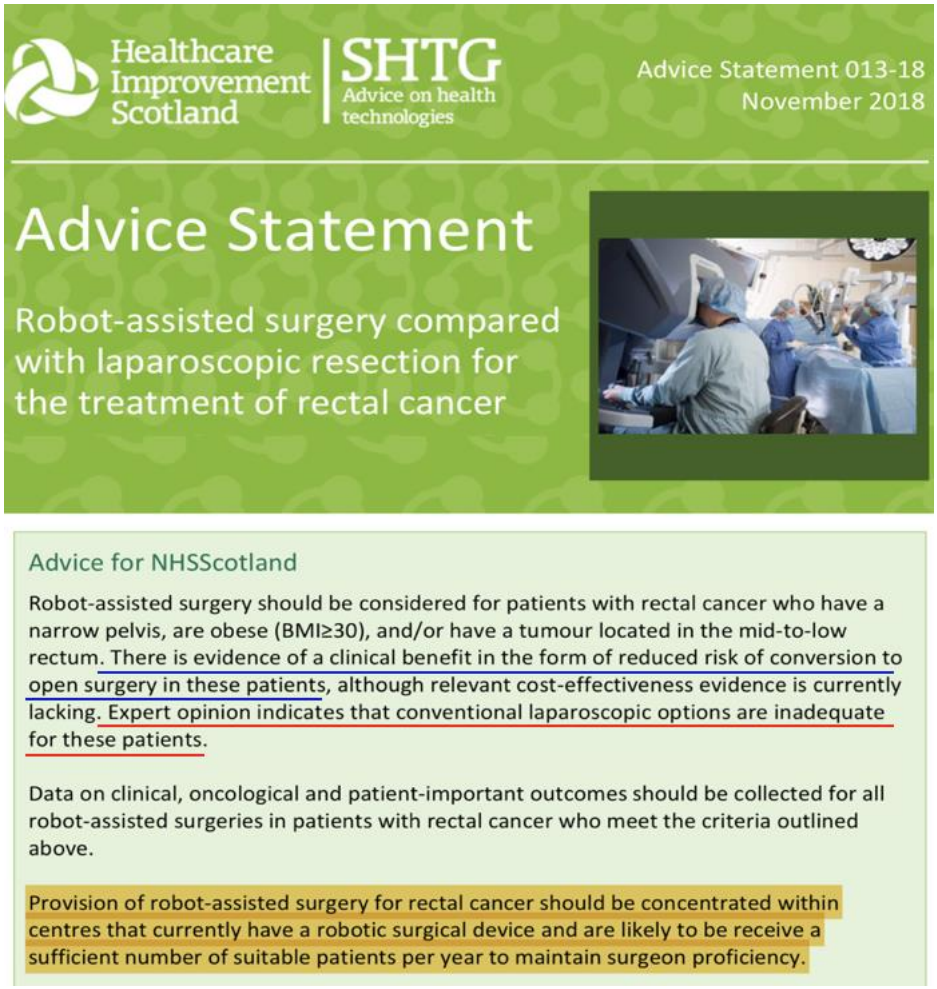
- 3D visualization allowing for precision surgery,
- 10x magnification
- Direct view with re-establishment of the eye-hand axis for the surgeon
- Better range of movement with instruments that allow seven degrees of freedom of movement (vs 5 with laparoscopy)
- Tremor filtering.

More ergonomic and reduced exposure to repetitive strain and fatigue inducing postures in the operating team personnel

Since 1998, over 8000 peer-reviewed publications have appeared in various clinical journals on da Vinci Surgery. The table below summarizes the level of scientific evidence for the clinical publications related to da Vinci Surgery. These levels of evidence are adapted from the March 2009 Centre for Evidence Based Medicine levels of evidence. - See more at http://www.intuitivesurgical.com/company/clinical-evidence/#sthash.uiOw5PwM.dpuf

Level of Scientific Evidence for Clinical Publications related to da Vinci Surgery

LEVEL	DESCRIPTION	New in 2Q 2014	Total
Level 1			
1a	Systemic reviews of randomized controlled trials	2	4
1b	Randomized controlled trials	1	16
1c	Randomized controlled trials for robotic technique studies	5	22
Level 2			
2a	Systematic reviews of only comparison studies and Independent database population studies	18	150
2b	Prospective non-randomized studies and RCTs with N<20	6	127
Level 3			
3a	Systematic reviews of mixed studies (comparison and single arm)	5	57
3b	Retrospective non-randomized studies and prospective comparison studies with N<20	80	906
Level 4			
4a	Literature reviews	14	94
4b	Single arm studies and retrospective comparison studies with N<20	136	2072
Level V	Case reports, Animal and Cadaver studies, Expert Opinion and Editorials	247	4720
TOTAL		514	8168



Healthcare Improvement Scotland published a statement in November 2018 on the role of RAS compared to laparoscopic resection in rectal cancer. The document highlighted the clinical benefits of RAS as conventional laparoscopic options are inadequate of these patients.

The statement recommends that RAS rectal surgery should be concentrated within centres that have facility to provide robotic surgery and likely to receive sufficient numbers to maintain surgeon proficiency. NHS Grampian is looking to take the lead and to build up the reputation as one of the leading national centres for rectal RAS. Undue delay in making the decision to adopt RAS in colorectal surgery in NHS Grampian could result in other centres in Scotland taking the lead on this initiative. If this happens, NHS Grampian could face a situation where rectal cancer patients have to be referred for other centres that have developed the expertise ahead of us. This will result in loss of local expertise in rectal cancer surgery with subsequent loss of expertise in supportive services which include specialist nurses, radiology and oncology. This would also have serious implications on training as NHS Grampian would lose its accreditation as training centre for colorectal surgery if surgical training in up-to-date management of rectal cancer is not provided.

Service Impact

The basic training required for the system has already been completed by the majority of the general surgery team with at least 1-2 members from each sub-specialty having used the platform. The training package offered by Intuitive Surgical will formalise this training enabling the team to progress to independent operative in a 4 week period.

It is anticipated that the transition phase will last around 12-18 months. To mitigate any potential impact on waiting times due to the learning curve the consultant body have agreed several initiatives aimed at ensuring that throughput is maintained, including potential changes to scheduling to maximise theatre utilisation, additional voluntary theatre lists and staggered adoption across sub-specialities.

The proposed model to maximise theatre utilisation is a flexible booking system where lists do not belong to named consultants but to sub-specialties. Thus, on a colorectal day, it will be possible for one consultant to book their robotic case in the morning and for a second consultant to book theirs in the afternoon. On a similar note, if there are no colorectal cases available, another sub-specialty like HPB, Endocrine or Upper GI with relevant cases could utilise the list. In this way the utilisation of the robot would be maximised not only making it an efficient service from the outset but also translating into a quicker attainment of proficiency for the team to realise the benefits of the approach for patients from very early on.

As explained in the introduction the MIT theatre has already been enabled for the introduction of the robotic equipment and does not require any additional investment in infrastructure. The facility will be available for use immediately to treat patients following the initial commissioning and testing phase.

Appendix 7

Robotic Assisted Surgery for Orthopaedics, Urology and General Surgery

Health Inequalities Impact Checklist

Date of Assessment: Mid November 2020	
Populations	**Could these groups be affected differentially by the proposal?**
Older people, children and young people	The smaller incisions made by robotic surgery compared to traditional open surgery means that it is accessible to a wider number of people who before would not be suitable for surgery. This includes the elderly population.
Women, men and transgender people	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
Disabled people	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
Minority ethnic people	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
Refugees and asylum seekers	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
People with different religions or beliefs	As part of the pathway of care, time is provided to discuss different surgery options. Where individuals may be against robotic assisted surgery, suitable alternatives will be discussed and provided where possible, along with the relevant risks for each.
Lesbian, gay, bisexual and heterosexual people	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
People who are unmarried, married or in a civil partnership	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
People living in poverty/people of low income	Smaller wounds and quicker recovery will enable quicker return to function. No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
Homeless people	Smaller wounds with fewer wound infections would mean a more comfortable recovery period. No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.

People involved in the criminal justice system	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable.
People with mental health illness	Some individuals with mental health illness may be wary or distrustful of technology assisting their surgery and may require additional support in understanding the process. A simple explanation of how the robot works to assist surgery should be prepared/available as part of the individual's consultations and has opportunities for questions to ensure no extra stress or anxiety is experienced.
People with low literacy/numeracy	This group may require additional support in understanding the process. A simple explanation of how the robot works to assist surgery should be prepared/provided as part of the individual's consultations to ensure the individual understands the process and has opportunities for questions in order to minimise stress or anxiety.
People in remote, rural and/or island locations	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable. There is already accommodation available for those travelling from remote and rural locations to ensure there is no financial burden to these individuals attending ARI for surgery. One of the benefits of robotic surgery is reduced length of stay (compared to traditional surgical methods) which will mean individuals will be away from home/family for a shorter time.
Carers	No obvious impact – the ESCAT system is robust and ensures access to surgery is fair and equitable. One of the benefits of robotic surgery is reduced length of stay (compared to traditional surgical methods) which will mean individuals will be away from home/family for a shorter time. One of the benefits of robotic surgery is quicker recovery and return to normal activities.
Staff	Robotic assisted surgery can reduce the risk of repetitive strain injuries/other occupational injuries experienced by staff sometimes acquired during non-robotic surgery. The procedures can be completed in a shorter amount of time, and with the assistance of the robot, less physical and mental strain is exerted.

Health Determinants	
What impact will the proposal have on health-related behaviour?	**Diet and Nutrition** – Potentially lower incidence of ileus post-operatively and less need for nutritional support. No obvious impact, staff will continue to advise patients on these aspects of care. **Exercise and Physical Activity** - Recovery and return to normal daily activities post-operation will be quicker than compared to traditional surgery **Substance use (tobacco, alcohol or drugs)** - No obvious impact, staff will continue to advise patients on these aspects of care and risks pre/post-surgery. **Sexual health** - No obvious impact, staff will continue to advise patients on these aspects of care. Potential for preservation of sexual function due to nerve sparing procedures. **Learning and skills** - No obvious impact
What impact will the proposal have on the social environment?	**Social status** - No obvious impact **Employment** - Potential to attract new staff to NHS Grampian to work in services due to the service having access to the surgical robot. There may be a benefit for a cohort of individuals whereby they will be able to continue to be fit for work/or return to employment as a result of their surgical and health outcomes. **Income and income inequality** – quicker recovery for those in employment will reduce the risk of adverse impact to income, particularly those who are self- employed or on short term/ad hoc contracts. **Crime and fear of crime** - No obvious impact **Family support and social networks** – reduced length of stay and quicker recovery linked to robotic surgery will mean the individual will be away from family and social networks for less time compared to traditional surgical approaches. Impact on family will also likely be reduced.

	Stress, resilience and community assets - reduced length of stay and quicker recovery linked to robotic surgery will mean the individual will be less likely experience less stress or increased demand on community assets compared to traditional surgical approaches. **Participation and social interaction** - reduced length of stay and quicker recovery linked to robotic surgery will mean the individual will be able to return to normal activities and role within community quicker than if they had traditional surgical approach. **Influence and sense of control** • There will be anxieties associated with robotic assisted surgery. Additional time may need to be factored in to provide reassurance to patients as the individual requires. • Patient choice remains at the centre of service delivery **Identity and belonging** - No obvious impact
What impact will the proposal have on the physical environment?	**Living conditions** - No obvious impact **Working conditions** - Conditions for the surgical team will improve as some of the strain of operating over long hours will be reduced. Procedures will be shorter and there will be a reduction in repetitive strain injury as a consequence of using the surgical robot. **Natural space** - No obvious impact **Pollution – air, water, soil** – No change from current approaches. **Climate change** - No obvious impact **Unintentional injuries and public safety** - Consistency of outcomes will be improved, along with a reduction in surgeon error and complications. Infection rates will be lower, and blood loss will be reduced. **Transmission of infectious disease** - Robotic assisted surgery reduces the

	likelihood of infection due to technology and also due to reduced length of hospital stay
How will the proposal impact on access to and quality of services?	**Healthcare** • Robotic surgery technology has shown to improve patient care, reduce unwarranted variation, reduce complications resulting in higher consistency and quality of outcomes • Robotic surgery will improve efficiency and productivity which in turn will support the service to see more patient, thus improving access and outcomes for more patients. • Robotic surgery reduces the risk of complications, co-morbidities and long term health and functional implications which therefore reduces the need/demand for health and social care services in the short and longer term. This will improve access for other individuals who require these services. **Transport and connections** - No obvious negative impact. **Social services –** Robotic surgery reduces the risk of complications, co-morbidities and long term health and functional implications which therefore reduces the need/demand for health and social care services in the short and longer term. This will improve access for other individuals who require these services. **Housing quality, mix, flexibility** - No obvious impact **Education provision -** There will be many training opportunities made available as a result of the acquisition of new surgical robots. NHS Grampian can become a centre of excellence and lead on training and development of robotic surgery – this will support recruitment and retention to services, supporting greater sustainability and improved access. **Culture, leisure and play provision** - No obvious impact

What impact will the proposal have on equality?	**Discrimination against groups of people –** No discrimination - access to service is solely prioritised based on clinical need and patient choice to proceed **Promoting equality of opportunity -** access to service is solely prioritised based on clinical need and patient choice to proceed **Tackling harassment** - No obvious impact **Promoting positive attitudes** - Integrating advanced technology will enhance patient care and support better outcomes for more patients **Promoting good relations between different groups** - No obvious impact **Community capacity building** - No obvious impact

Summary/Recommendations

Name of proposal

Robotic Assisted Surgery for Orthopaedics, Urology and General Surgery

Date of screening

25/11/2020

Issues arising from initial screening (including any further requirements)

No major issues arising

Recommendations

The ESCAT system already provides robust mechanisms to ensure fair and equitable access to surgery based on clinical need. There will be no change in how this is implemented for robotic assisted surgery. The addition of these robots does not disadvantage any groups, and in fact improves access to the elderly and those with multiple morbidities who would have been considered too high risk for traditional surgery approaches. The implementation of this proposal will also see increased throughput due to increased efficiencies and reduced length of stay, supporting improved access to services by other patients.

Accommodations will need to be made to support individuals who are anxious about robots being involved in their care. The need to ensure individuals have the right level of information and support to make appropriate choices/decisions and reduce anxieties will be undertaken as part of the implementation plan/pathway of care.

Similarly, there are no disadvantages to staff as a result of this project. Appropriate training schemes will be in place to ensure all staff are comfortable using the technology. The addition of robotic assisted surgery serves to reduce the strain and burden that traditional surgery carries for staff. It will also increase the number of surgeons able to operate with such technology in a much shorter timescale (when compared to traditional techniques) increasing the cohort available to operate on patients. Experience elsewhere has shown such developments support positive recruitment and retention of key workforce groups.

Name and e-mail of implementation lead (s)

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Timescale for implementation:

New surgical robots expected to go live with the first patient receiving robotic surgery early April 2021.