BRITISH ASSOCIATION OF UROLOGICAL SURGEONS (BAUS)
ROBOTIC SURGERY CURRICULUM - GUIDELINES FOR TRAINING

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1. Introduction

Since the first robotically assisted laparoscopic radical prostatectomy in 2000 (Binder and Kramer, 2001), many urological and other surgical procedures have been undertaken using robotic assisted surgical (RAS) techniques. Currently there is only one medical robot system the “Da Vinci” available in the market developed by Intuitive Surgical. At the end of 2013, over 2800 Da Vinci systems were functional in the world and half million surgical operations had been undertaken using a robot. Urology has been at the forefront of robotic surgery. Robotic assisted radical prostatectomy is the most common operation, but now partial nephrectomy, radical cystectomy and pyeloplasty are regularly undertaken using a robot.

Last year around five thousand radical prostatectomy operations were performed in the UK, around 60% of which were done using a robot. A systemic analysis undertaken by the Health Technology Assessment (HTA) has shown that RAS prostatectomy leads to a lower incidence of positive margin and urethral stricture rates (Ramsay et al., 2012). Robotic surgery offers several advantages to other minimally invasive techniques such as stabilization of instruments within the surgical field, improved ergonomics and superior visualization of the operative field (Herron et al., 2008). Patient outcomes are therefore potentially improved (Herron et al., 2008, Nevada, 2013). A long-term follow-up of clinical outcomes of robotic surgery may prove it to be cost-effective due to lower incidence of complications. This situation is further set to improve with entry of other providers of medical robots into the market decreasing the costs of acquisition and maintenance of a robotic system (Ahmed et al., 2012).

Proficiency in robotic surgery is not currently a component of specialist training in Urology although it is recognised that some trainees would wish to gain the opportunity to develop and further their skills in this area. It is highly likely that those trainees who wish to develop a career in robotic surgery will need to spend time after CCT, gaining the necessary competencies.

This document sets out to:

- Review the skills required within robotics.
- Discuss current training methods for robotic surgery.
- Establish methods for modular training.
- Confirm the need and methods for centralised outcome data-collection.

2. Skillsets required within Robotic Surgery

Skills that require development during training can be classified into technical and non-technical skills. Technical skills are those required to efficiently and safely perform a specific procedure and are seen as what underpin a surgeons' ability (Baldwin et al., 1999). Technical skills can be divided into:

- Learning to use a robot
- Learning a specific procedure

An individual, who lacks the appropriate technical skills, should not conduct any surgical procedure. These skills must therefore be learnt, practiced, maintained and enhanced.

Non-technical skills (NTS) are as important within robotics as any surgical procedure and have the added challenge of remoteness between the primary surgeon and the assistant/scrub nurse. NTS can be classified according to cognitive skills (situation awareness, decision making and planning), social skills (communication, teamwork and leadership) and personal resource factors including the ability of an individual to cope with stress and fatigue (Flin et al., 2008). Situation awareness is required for any robotic surgeon as the surgeon is placed at a distance from the patient and they need to know what is happening by the bedside. Other attributes such as leadership and communication are additionally important for effective interaction and co-ordination of the numerous staff present in a robotic procedure. These non-technical skills are not traits acquired from birth but can be taught and enhanced through training (Brewin et al., 2013).

As robotic surgery involves an enhanced team working efficiently, it is imperative to train advanced care practitioners / nurses along with surgeons with specific roles assigned which would develop and support a competent theatre environment.

Surgeons who are learning robotics can be divided into two broad categories; firstly that group of specialists with extensive previous experience of open and/or laparoscopic prostate, renal and bladder procedures who are now learning robotic procedures. The second group is the group of trainees who are new to any form of urological procedures including open, laparoscopic and robotic surgery.

The requirements for both of these groups are different and require careful consideration when deciding on learning needs. Therefore the training pathway for these two groups may differ in contents and duration.

3. Current training practices

In the UK there are currently no structured pathways, guidelines or curricula for robotic surgery training. To date neither the GMC nor the Royal College of Surgeons accredit clinicians with particular urological technical skills. Skills are usually acquired through a mixture of observership, mentorship with on the job training and fellowships.

3.1 Observership

Observation of practice is crucial first step within robotics (McDougall et al., 2006) and can occur at urological meetings and within a robotic centre locally. Surgeons will observe **complete cases**, having the opportunity to ask questions to cover gaps in their knowledge. Principles of robotic surgery can be learnt in this manner. Observership is important to the specialist trainee learning robotics and the novice training for new procedures entirely. Experts will focus primarily on differences of robotic approaches as compared to previous laparoscopic and open techniques. A novice will however have entirely different learning goals with an emphasis on learning the principles of a procedure. While observership is beneficial in the early stages of training, it offers limited scope for development of technical skills.

3.2 Simulation Based Training

Training within robotics is difficult due to limitations imposed by current working hours pattern, increased litigation and financial constraints (Abboudi et al., 2013a). Therefore in addition to observership, mentorship and fellowships there is an emerging role for simulation in order to practice away from patient in a safe and risk free environment to reduce the initial phase of the learning curve (Ahmed et al., 2011a). Several virtual reality da Vinci Surgical System simulators are currently available in the market, each having been validated to differing degrees. Current levels of evidence must allow for these to be integrated as an adjunct to training within the intermediate stage of a training programme (Abboudi et al., 2013a). Robotic simulators currently teach basic technical skills (Lallas et al., 2012) and are best used to learn these prior to full procedure simulation. Simulation should not be used as the lone method of training but should be integrated within a comprehensive curriculum (Ahmed et al., 2011b).

3.3 Mentorship

Mentoring is defined as "*The process whereby an experienced, highly regarded, empathic person (the mentor), guides another individual (the mentee) in the development and re-examination of their own ideas, learning, and personal and professional development*" (Surgeons, 2013). This requires a mentor who through exchange of knowledge, practical learning and continuous feedback will enhance a trainee's surgical skillset (Gagliardi and Wright, 2010). This process is highly dependent on a competent mentor who is required to be skilled and experienced in the procedure and must be able to teach these skills effectively (Souba, 1999). Additionally it is a process that requires dedication, perseverance and a great deal of time. The current design of the third generation da Vinci Robot allows supervision with two consoles, albeit at significant cost.

Structured mentorship programs within robotics are required for effective teaching (Abboudi et al., 2011, Hay et al., 2014). This involves preoperatively setting learning objectives in the form of "an educational contract" followed by the mentor observing an element of the robotic procedure. Following completion of a period of appropriate observation, partial and then full completion of robotic procedures can be conducted. The mentor must have full occupational health clearance and an honorary contract in the mentee's hospital so as to be able to intervene if necessary and the patient should be appropriately consented. A formal sign-off process then occurs whereby structured feedback can occur (Abboudi et al., 2011).

An extension of mentorship can occur via telementoring. An expert can guide, direct and interact with another surgeon in a separate location during a surgical procedure (Challacombe and Wheatstone, 2010). This arises in the form of a real-time video link of a procedure in where an expert will provide verbal guidance to the performing surgeon. Telementoring has a large potential role within robotics as procedures viewed via monitors are especially suited for transmission to other sites. Telestration offers an extension of telementoring involving illustration of target areas on the local screen.

In the near future, telementoring can be extended via tele-assistance where a surgeon can assist within a procedure by taking over the robotic arm. High-speed and secure connection are crucial for effective telementoring as time lags can severely hamper quality of mentorship and of the operation (Santomauro et al., 2013).

3.4 Fellowships

Structured programmes are often delivered in the form of formal fellowships. Several fellowship structures have been developed; many offer a modular approach to training. A surgeon would progressively develop skills of an entire procedure by learning increasingly difficult segments of it (Stolzenburg et al., 2006). Non-modular fellowship training methods are an alternative and have also been demonstrated to be an efficient method of teaching within robotics (Zorn et al., 2007, Hay et al., 2014).

Mini-fellowships are an intensive alternative for experts seeking to enhance their skills in robotic surgery. These short programmes often offer simulation and animal/cadaver training along with operating room observation. Mini-fellowships encourage those who are familiar with laparoscopic practice to successfully incorporate robotic surgery within their practice (McDougall et al., 2006).

3.5 Transition to independent practice & sign off

The process of transition to independent practice within robotics is still evolving. Certification has been defined as “confirming a specific or pre-determined level of knowledge, skills or attitudes through a formal assessment process” whilst credentialing is defined as “an objective process of establishing the qualifications of individuals or organisations through a formal assessment or evaluative process” (Dasgupta et al., 2014). Independent practice in robotic assisted surgery should not be based on the number of completed cases but should be done via demonstration of proficiency and safety in robotic procedural skills (Lee et al., 2011). These needs include an expert /mentor responsible for determining the standardized minimum criteria of a robotic surgeon’s proficiency. Objective operative and post-operative criteria should be utilised for this and therefore these parameters will be procedure specific. Following this process a surgeon can be expected to safely and effectively conduct procedures independently.

4. Recommended Curriculum for BAUS

A five-stage curriculum for robotic training is proposed largely based on the content validated model proposed via the EAU Robotic Urology Section, ERUS (figures 1 and 2).

Figure 1: EAU Robotic Urology Section (ERUS) proposed curriculum (Ahmed et al., 2014, Volpe et al., 2014)

Novice trainees entering the curriculum do not require to have previous laparoscopic or even open urologic experience as this does not negatively affect an individual's learning curve for robot assisted surgery (Abboudi et al., 2013b). Similar training pathways should be carried out for trained open/lap surgeons seeking training within robotic surgery. However, training requirements and length of training will vary between these two groups. It is recommended that trainees gain experience through designated post CCT fellowships before embarking on independent robot assisted surgical practice. In association with the Section for Oncology, BAUS will seek to support the development of high quality post CCT fellowships in robotic surgery.

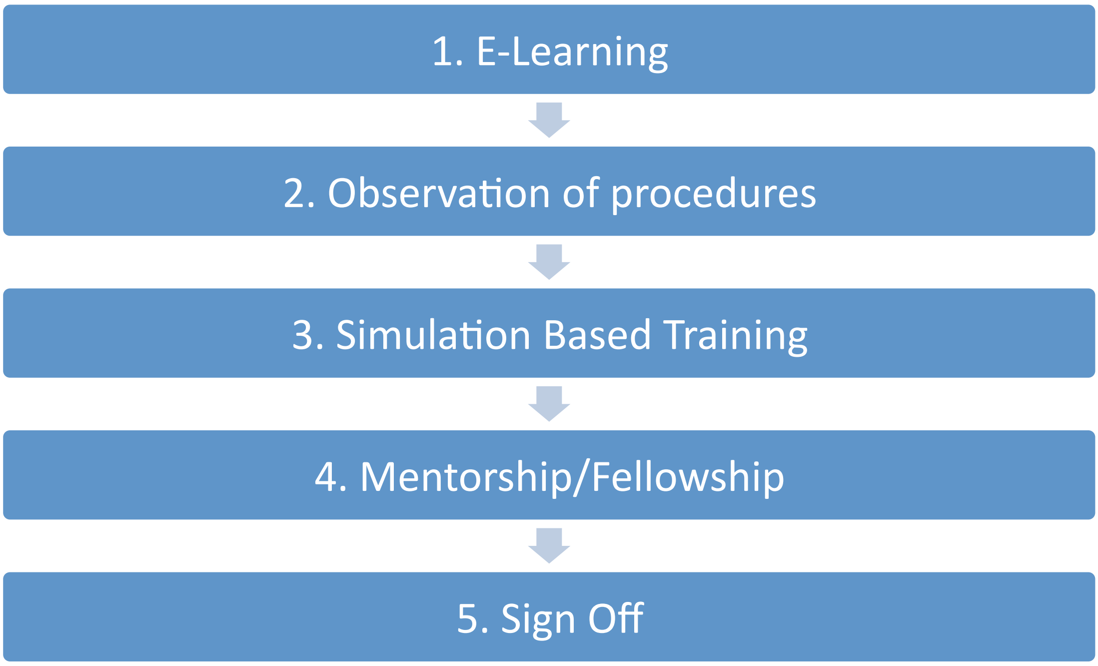

Figure 2 – Outline of BAUS standardized training pathway

Procedures should be trained for and assessed in order of increasing technical demands (Box 1). Therefore, the first procedure conducted should a simpler one starting from robot-assisted pyeloplasty or laparoscopic radical prostatectomy (RARP) depending on the service provision and case mix of the centres. Many surgeons coming to robotic surgery will have extensive laparoscopic experience, it is reasonable that robot-assisted radical nephrectomy or nephro-ureterectomy (RARN) should be mastered to allow skills to be developed in hilar dissection prior to commencing robot-assisted partial nephrectomy (RAPN) in units focusing on upper tract surgery. Robot assisted radical cystectomy (RARC) with open urinary diversion should be the next goal on units focusing on pelvic surgery.

The training pathway for learning each procedure is similar, however the sign off and certification process will vary in parameters (described in figure 5) utilised to assess the surgeon according to common quality indicators utilised in each procedure.

Box 1: BAUS recommended potential stages for upper tract and pelvic procedures

Upper Renal Tract Surgery:
- Robot assisted pyeloplasty (RAP)
- Robot-assisted radical nephrectomy (RARN)
- Robot-assisted partial nephrectomy (RAPN)

Pelvic Urological Surgery:
- Robot assisted radical prostatectomy (RARP)
- Robot assisted radical cystectomy (RARC) with extracorporeal diversion
- Robot assisted radical cystectomy (RARC) with intra-corporal diversion or neo-bladder

4.1 E-learning

A sound knowledge of console and procedure theory is required. All individuals training for robotic surgery should undergo online training prior to progression in the curriculum. Intuitive Surgical offers an online training system via its da Vinci surgical community online theoretical training for the purpose of product training (Intuitive Surgical, 2014). This covers an introduction to da Vinci surgery and basic system training. Completion of modules may be demonstrated via the certificate of completion provided. Specific robotic urology online modules can then be completed. The European Association of Urology has developed an online training system titled eBRUS, which aspiring urological robotic surgeons may find useful.

4.2 Observation

Surgeons should observe designated robotic procedure prior to practical training in high-volume centres where operating surgeons are experts. This should enable a good understanding of the robotic procedures. Special attention should be given to the steps in conducting a safe and effective robotic procedure. Observation will involve travel for those in centres with newly acquired consoles:

4.3 Simulation Based Training

There are a number of virtual reality (VR) simulators available which robotic surgeons may find useful (Abboudi et al., 2013a). These include the Robotic Surgical Simulator

(RoSS) which has demonstrated face and content validity with a proven educational impact. The Simsurgery Educational Platform (SEP) developed in Norway demonstrates proven face, content and construct validity. The remaining three platforms available include the ProMIS system, the Mimic-dV Trainer (MdVT) developed in the USA and the da Vinci Skills Simulator (dVSS). These three platforms have all been validated to the same extent including their face, content and construct validity with a proven educational impact.

The simulator utilised during the robotic training pathway vary between training centres depending on resources available. Currently the most commonly used simulator is the dVSS simulator, which can easily be attached to the back of the da Vinci console. In addition to VR simulation, dry lab exercises should be utilised which include both basic (object movements and suturing) and advanced tasks (anastomosis on synthetic models).

Live animal training is commonly used with an excellent feedback across Europe but is not permitted in the UK. However, a few centres have access to cadaver training and the training utilising animal tissues. The costs with travel to countries where animal or cadaveric modalities are considerable, effectively make it not cost-effective (Ahmed et al., 2011b) BAUS recognise that there is a need to develop cadaver based robotic training as a part of simulation in established cadaver training centres in the UK.

While a number of simulation-based curricula have been developed (Fisher et al., 2015), the ERUS Robotic Urology Fellowship Curriculum model offers the most extensive and comprehensive model (Figure 3). Once completion of the e-learning phase is confirmed to be complete, basic skill development can occur through simulator and dry-lab exercises. The individual surgeon may find it useful to attend an intensive course at a centralised institution covering further skills via simulation and dry skills, supplemented by a theoretical exam. With basic skills acquired the surgeons may progress into a console modular training pathway where a modular approach to a selected procedure is undergone through simulators and dry lab exercises. Simulation training may conclude with a final evaluation whereby a full procedure is assessed using both technical and non-technical skills markers such as the Global Evaluation and Assessment of Robotic Skills (GEARS) and the Non-Technical Skills for Surgeons (NOTSS) assessment sheets (Brunckhorst et al., 2014, Yule et al., 2006)

Training centres will require adequate simulation facilities (simulators and dry lab) with experts to teach robotic skills. In time, training centres will require accreditation (supported by BAUS, Section of Oncology and RCS) to ensure minimal standards are maintained.

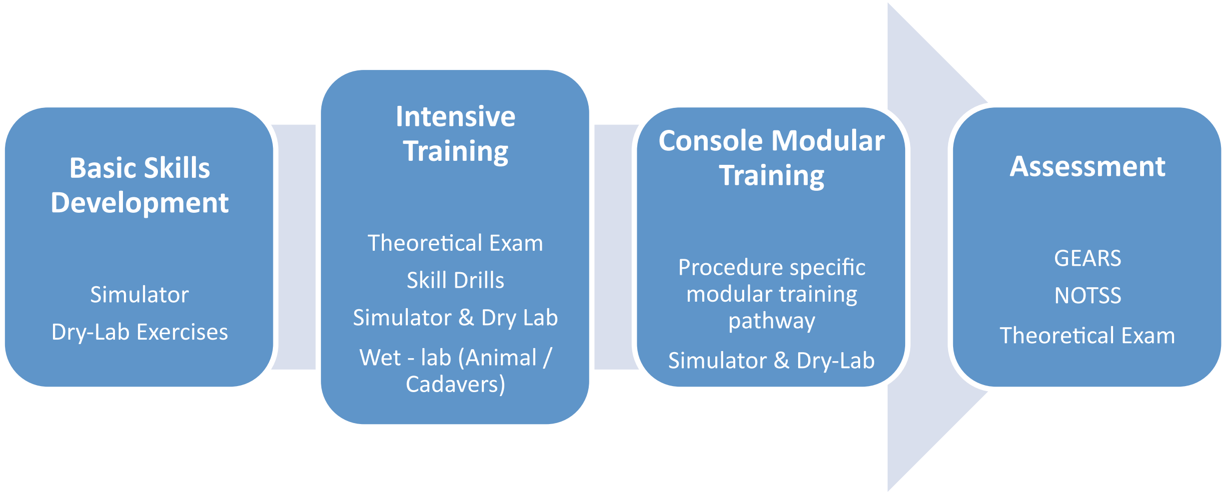

Figure 3 – Simulation based training outline (Section)

4.4 Mentorship / Fellowship

This should occur in a structured and pre-determined modular pathway, see below. Mentorship programmes require considerable time and dedication to be successful and a large caseload is essential for the learners.

Fellowships are an alternative to mentorship programmes for post CCT surgeons. Several programmes are currently in place across Europe, US and Australia at various centres of excellence (Surgery, 2013, Murphy, 2012). It is important that these fellowships offer similarly structured programmes to ensure effective acquisition of robotic skills. Experienced surgeons (frequently urology consultants with extensive laparoscopic experience), but not familiar with robotics, may undergo a mini-fellowship. These offer short and intensive programmes in principles and skills for robotic surgery suited for those who must build upon already acquired skills.

Appropriate sign-off is still required for this group

Mentoring and training must be in high volume centres that are off their "learning curves".(NICE Guidelines, 2014)

4.5 Team Training

Team training improves operating theatre efficiency. It is imperative that the entire team is trained in robotic techniques including theatre set-up, robotic docking and trouble-shooting the robot. Arrangements must be made for training of the nursing staff and surgical assistants (if needed) with designated senior theatre staff addressing potential issues in Trusts over releasing staff for training. Team members should also observe cases at the high-volume centres and should take part in simulation based full immersion (operating theatre) training. Individual institutions are responsible for training of the teams. BAUS will also forward the recommendations to the Royal College of Nursing and to the British Association of Urological Nurses (BAUN).

4.6 Sign Off / Completion of Training

Prior to independent practice a surgeon has a duty of care to ensure that he/she is appropriately trained and is safe and effective with robotic techniques. Trainees in fellowship posts may need to complete accredited fellowships before sign off. Consultants should demonstrate safe practice within robotic procedures and sign off by a mentor / assessor may be required by the Trust's medical director. Formal quality indicators for each procedure should be signed off by the mentor. These parameters are highlighted within Figure 4.

It is good practice for consultants to keep a log and evidence of completion of all stages of the training pathway along with demonstration of safe practice. Minimum caseloads should correlate to the learning curves associated with the procedure. Similarly edited videos and patient outcomes may help provide evidence of proficiency in robotic techniques.

BAUS will endeavour to support those clinicians who are seeking support for the development of a robotic assisted programme. Designated mentors should be able to assess individual surgeons using objective assessment criteria.

High quality skills should correlate with good operative outcomes. All consultants should contribute with the centralised outcome data-collection the via BAUS databases.

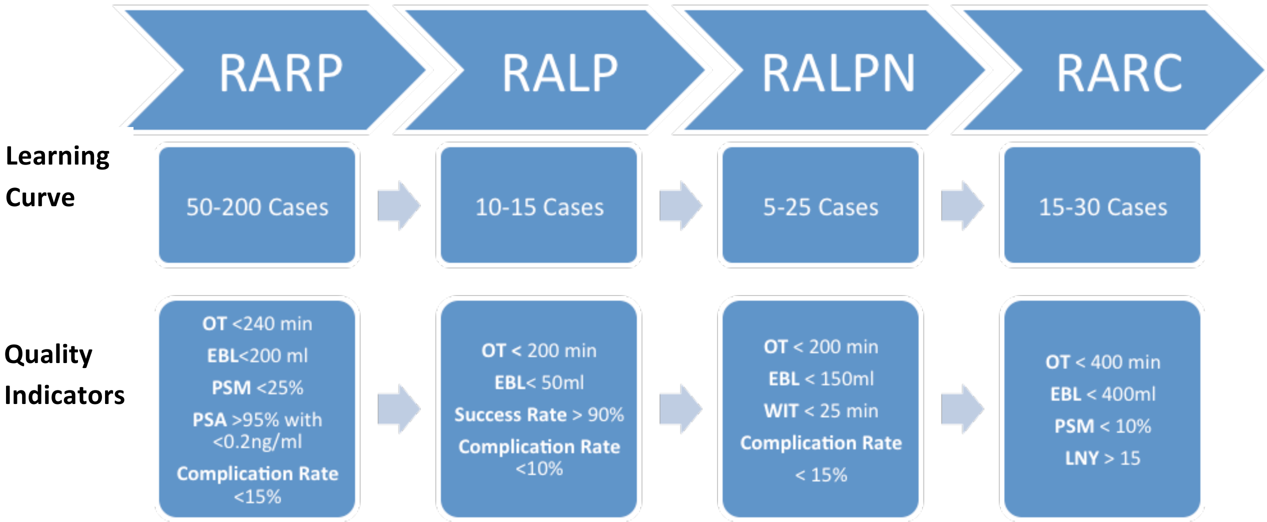

Figure 4 – Sign off Recommendations based on current evidence (Abboudi et al., 2013b)

OT – Operative Time, EBL –Estimated Blood Loss, PSM – Positive Surgical Margins, PSA- Prostate Specific Antigen, WIT – Warm Ischaemia Time, LNY – Lymph Node Yield.
RALPN - Previous experience of renal hilar dissection (laparoscopic or robotic assisted) is recommended.
RARC - Previous pelvic surgery (open or laparoscopic) recommended

5. Modular training pathways

Modular training is to be used within mentorship and fellowship schemes. This offers a structured and effective method (Stolzenburg et al., 2006) of teaching. Modular training involves a mentor performing a series of operations with the trainee surgeon acting as an assistant and once confident the procedure can be conducted by the trainee surgeon with the mentor acting as the assistant (Fabrizio et al., 2003). The trainee would not perform the entire procedure at first attempt but instead, progressively develop skills of an entire procedure by learning increasingly difficult segments of it (Stolzenburg et al., 2006). Once all steps of a procedure are learnt effectively, full procedures are attempted. Within the four suggested procedures within the standardised pathway suggested steps are outlined in Figure 5.

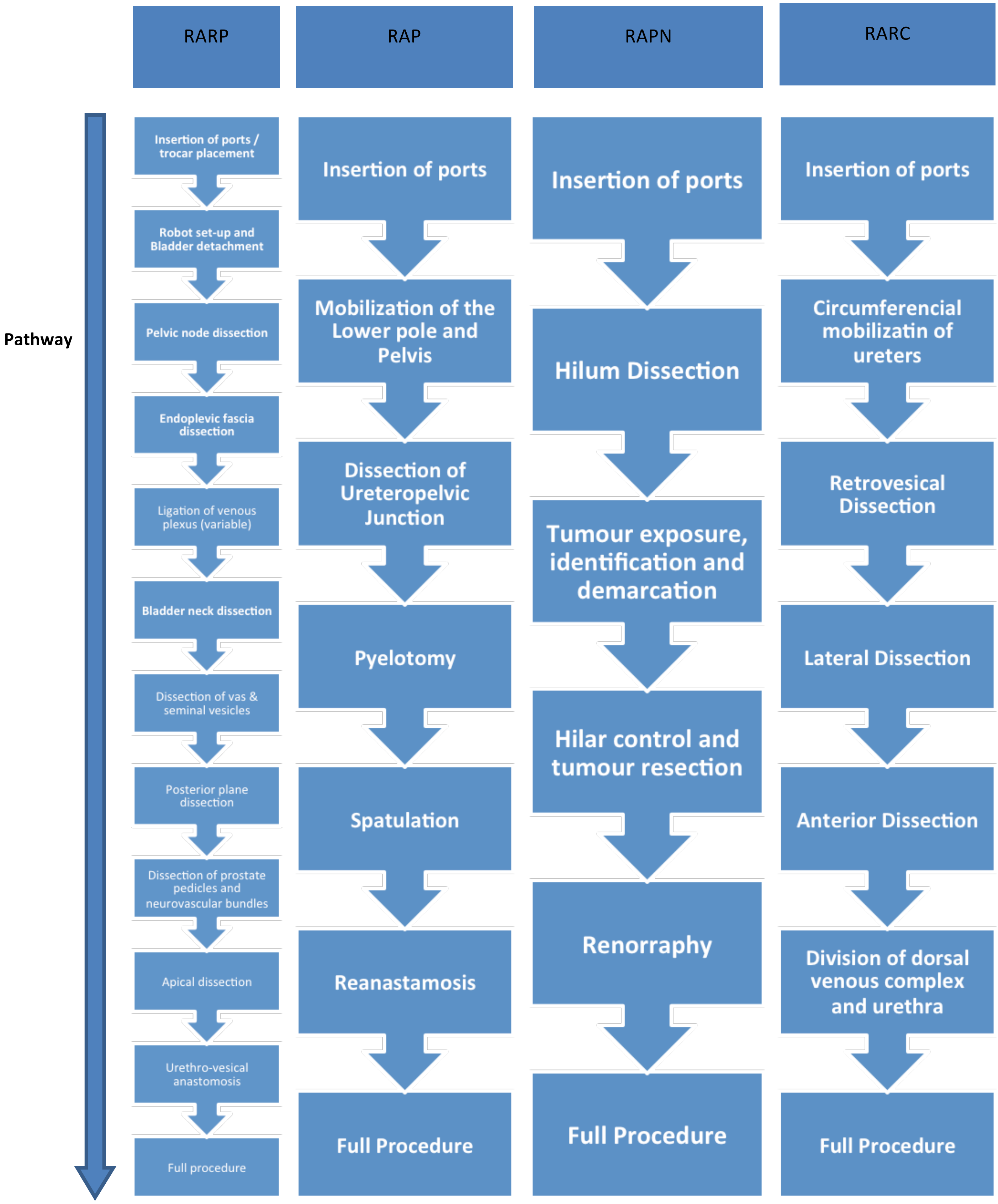

Figure 5 - Modular training pathways

6. Centralised Outcome Data Collection

Since March 2013 the Healthcare Quality Improvement Partnership (HQIP) Outcomes Publication team have worked with audit providers, specialist associations and the Royal College of Surgeons to publish data related to surgical outcomes. BAUS has published audits of nephrectomy, partial nephrectomy (open laparoscopic and robotic) from 2012 and 2013 and intends to publish 2014 data on prostatectomy (open laparoscopic and robotic) in 2015. BAUS will endeavour to co-ordinate a similar service for all robotic procedures via the existing procedure specific audits on the website. Hence national data will be collected from institutions with robotic consoles installed. Ideally this is best conducted by trained data abstractors at the institution of common operative outcome measures for individual procedures. By maintaining a centralised system of data collection, BAUS can support the development of benchmark performance criteria, promote quality initiatives and aid in guideline development (Shahian et al., 2013). It is BAUS' intention to publish yearly audits of data input to promote quality and consistency. The process is contingent on support from individual robotic surgeons and their institutions. Individual reports can be given to participating surgeons, which aids in highlighting good practice, potentially identifying issues relating to clinical practice and can be utilised in institutional audit processes. Furthermore, data captured can be utilised within the process to ensure minimal patient outcomes are met and maintained by surgeons wishing to practice independently.

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