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Training the gynaecological oncologists of the future – challenges and opportunities

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Abstract

Several recent advances in gynaecological cancer care have improved patient outcomes. These include national screening programs for cervical cancer as well as neoadjuvant chemotherapy for ovarian cancer. Conversely, these advances have cumulatively reduced surgical opportunities for training creating a need to supplement existing training strategies with evidence-based adjuncts. Technologies such as virtual reality and augmented reality, if properly evaluated and validated, have transformative potential to support training. Given the changing landscape of surgical training in gynaecology oncology, we were keen to summarise the evidence underpinning current training in gynaecological oncology.

In this review, we undertook a literature search of Medline, Google, Google Scholar, Embase and Scopus to gather evidence on the current state of training in gynaecological oncology and to highlight what evidence there is regarding the best methods to teach surgical skills. Drawing from the experiences of other surgical specialties, we examined the use of training adjuncts such as cadaveric dissection, animation and 3D models as well as simulation training in surgical skills acquisition. Specifically, we looked at the use of training adjuncts in gynaecological oncology training as well as the evidence behind simulation training modalities such as low fidelity box trainers, virtual and augmented reality simulation in laparoscopic training. Finally, we provided context by looking at how training curriculums varied internationally.

Whereas some evidence to the reliability and validity of simulation training exists in other surgical specialties, our literature review did not find such evidence in gynaecological oncology. It is important that well conducted trials are used to ascertain the utility of simulation training modalities before integrating them into training curriculums.

Introduction

Gynaecological oncologists are highly trained surgeons equipped with the knowledge and skills to manage gynaecological cancers. Skills and competencies required by a qualified gynaecological oncologist should be achieved through a formal subspecialty or fellowship training program within a standardised and quality assured training curriculum.

Several challenges exist in the training and acquisition of surgical skills by trainee gynaecological oncologists, exacerbated by recent positive advances in cancer care. Neoadjuvant chemotherapy and delayed debulking surgery has non-inferior survival and lesser morbidity than primary surgery for ovarian cancer (1). Increasing neoadjuvant chemotherapy use has reduced utilisation of primary debulking surgery in ovarian cancer, resulting in fewer opportunities for training in surgical procedures such as bowel resection, diaphragmatic stripping and splenectomy (2). Successful screening and vaccination programs in high income countries have reduced cervical cancer incidence, resulting in fewer cervical cancers and correspondingly reduced need for Wertheim hysterectomies (3,4). Effective medical management for menorrhagia and benign gynaecological conditions have resulted in fewer hysterectomies being performed during general gynaecology training (5). This has the potential to impact readiness for higher gynaecological oncology training amongst obstetrics and gynaecology trainees. In addition, there are well documented challenges to the acquisition of traditional skills in complex open surgery imposed by limited surgical exposure, limited surgical case volume, as well as the introduction of minimally invasive surgery (6,7). Minimally invasive surgery, in addition to reducing training opportunities for open surgery, also presents a distinct, steep learning curve (8).

Furthermore, existing concerns regarding gynaecological surgical training in the past decade and the resultant trainee-trainer dissatisfaction have been substantially aggravated by the disruption caused by the coronavirus (COVID-19) pandemic (9). Working hour restrictions in Europe, the United Kingdom (UK) and the United States of America (USA) alleviate trainee fatigue and reduce burnout but may also adversely impact surgical exposure (10,11).

Coinciding with fewer surgical opportunities for trainees, the present-day trainee is also confronted with a requirement for greater skill complexity (e.g., upper abdominal surgery, surgery for recurrence and a patient population with increasing frailty and comorbidities, including obesity). It is imperative, therefore, that we consider carefully how training curriculums and programs can be augmented and standardised to respond to the challenges of the modern-day cancer workload.

Several solutions have been proposed to address these challenges in gynaecological oncology training including traditional methods, like cadaveric dissection and innovative technologies such as simulation training; virtual reality for laparoscopy and robotics training. Critically, it is not known whether these training methods translate to real life surgical competency or improved patient outcomes, and most have not been independently validated. As an exemplar for simulation training, Hays et al. in their meta-analysis explored the important characteristics associated with effective simulation training in the aviation industry and demonstrated that the use of flight simulators combined with aircraft training led to skills improvements in jet pilots compared to training with aircraft only. Training effectiveness was dependent on task type, as well as the amount and type of simulation training received (12).

In this narrative review, we examine the evidence for various methods of acquiring the relevant surgical skills pertaining to gynaecological oncology, including laparoscopic simulation training within the sub-speciality and general gynaecology. We also summarise key findings, deficiencies and highlight the need for research in this area to provide robust evidence by presenting examples from other surgical disciplines, e.g. colorectal cancer surgery, that could be useful models for gynaecological oncology. Finally, we describe gynaecological oncology subspecialty training programs across high-, middle- and low-income countries. The former aimed at providing context and highlighting disparities in training structure which will need to be addressed to create high quality but resource sensitive, adaptable gynaecological training curricula to tackle the global gynaecological cancer challenge.

Methods

We conducted a literature search of PubMed (Medline), Embase, Google, Google Scholar and Scopus to identify what evidence exists to underpin surgical training in gynaecological oncology, general gynaecology and other surgical specialties. We also searched the above databases for literature around the structure of gynaecological training programs and curriculums globally across both low- and middle- income countries (LMIC) and high-income countries (HIC). We included recognised subspecialty training programs both under the remit of obstetrics and gynaecology as well as general surgery and also included initiatives towards the acquisition of gynaecological oncology skills outside of a formal subspecialty program. We acknowledge there may be existing programmes we have not included where we could not locate sufficient information to be included in this review. We reviewed evidence to augment surgical training from related specialties, e.g., colorectal, hepato-biliary and upper abdominal surgery, that can be adapted to gynaecological cancer surgery.

We used search terms ‘surgical training’, ’train the trainer’, ’cadaveric dissection course’, ‘upper abdominal surgery’, ‘colorectal surgery’, ‘gynae-oncology’ (or related terms, i.e., each cancer in turn), ‘trainees’ (or related terms) and proposed modes of teaching, including ‘training’, ‘augmented reality’, ‘virtual reality’, ‘simulation’, ‘haptics’ and ‘cadaveric dissection’. We have chosen not to include training in this review using live animal models as these methods are expensive, require infrastructure investment and are difficult to scale.

Current State of Training

Our scoping search identified two key themes from the current state of gynaecological oncology training. The first theme highlighted in an experiential survey of European gynaecological trainees related to dissatisfaction with clinical training whilst the second stressed the need for update and standardisation of training programs (13). Gan et al. summarise results from a prospective web-based survey of gynaecological oncology trainees within the European Network of Young

Gynaecological Oncologists. Their results highlighted poor ratings in both training and experience in advanced laparoscopic surgical training and robotic surgical training, due to the paucity of centres offering these treatment modalities (14).

Lack of exposure to radical surgeries has been reported within the UK and Europe, with trainee feedback highlighting the need for additional training in radical surgery (15). Roque et al. in the USA discussed the challenges affecting the rapidly changing field of gynaecological oncology as a surgical specialty, highlighting some of the advances in surgical approaches which has led to training deficiencies. They looked at challenges posed by the complexities of the American gynaecological training structure such as the lack of standardisation of training as well as a workforce demographic shift towards a growing number of female trainees. Trainees are generally seeking a better work-life balance including time away for family priorities (7).Several challenges currently in gynaecological oncology training have been experienced in other surgical specialties and it will be useful to draw from their experience in the early application of adjunctive strategies for training.

Evidence for surgical skills training

There are various training methods to suit a range of surgical approaches: cadaveric dissections, live animals and open simulators to guide open surgical approaches, box simulators to guide laparoscopic techniques and Virtual and Augmented reality to guide robotic approaches (16,17). It is worth discussing concepts around measuring surgical performance prior to exploring these modalities in detail.

Impact of surgical training techniques

Test reliability is the extent to which a modality can produce stable and consistent results. Using inbuilt tasks within virtual reality simulators, reliability can be tested by the trainee's ability to complete various psychomotor tasks and Objective Structured Assessment of Technical Skills (OSATS) that measure surgical dexterity parameters, time taken to complete task and complication rates. However, these tasks have been shown to lack reproducibility of results when completed multiple

times (test-retest reliability) as well as lacking consistency of results in a standard peer review process with different trainers (inter-rater reliability). Therefore, virtual reality validation for use as part of a standard curriculum must include a follow-up of the trainee's learning curve and the use of two or more senior reviewers to establish aspects of the test reliability (18).

Test validity is the ability of a measuring tool to measure what it claims to measure. When a test appears to measure what it purports to measure by using the right parameters, then it has content and face validity. The level of sophistication of modern high fidelity virtual simulators with integrated advanced virtual reality lens for orientation and haptic feedback allows for easy validation of the face and content validity. The test construct validity ensures a virtual reality tool actually assesses surgical competencies. The construct validity of laparoscopic simulations can help distinguish between surgeons of different competencies or skill levels (18). The construct validity reflects the subject's ability to learn skills on the virtual reality simulator that translate to real life surgical skills. Shore et al. showed that the use of comprehensive simulation training amongst Obstetrics and Gynaecology trainees improved technical knowledge and performance in theatre compared to conventional residency training (19). The predictive validity of laparoscopic simulation training is useful in determining which virtual reality skills best predict patient safety, clinical outcomes and clinical performance (blood loss, instrument path, and operating time) (8,20,21).

Adjuncts to skills training

Amongst the available training modalities in surgical training, there is a paucity of evidence regarding the most effective method. Currently, the master-apprentice or expert-guidance model is used to train surgeons in open surgery and is embedded in the development of surgical techniques and practice. There are various adjuncts to surgical training; modalities include cadaveric dissections, 3D printing and animation and simulation training of various fidelities. Simulator fidelity refers to how closely the simulator can replicate life experiences and this is broadly classified into low and high-fidelity trainers. High-fidelity simulators such as virtual and

augmented reality are most commonly employed in procedural training (22). Augmented Reality as opposed to Virtual Reality utilises a real-world setting so users are controlling their presence in the real world, as opposed to a fictional reality alone which usually lacks haptic feedback. Laparoscopic box trainers are a common example of low-fidelity simulators.

Cadaveric dissections are an established training adjunct which have been used in surgical specialties for surgical training and skills augmentation with varying but generally good results, depending on the type of specimen and degree of embalmment (23,24). A prospective Randomised Controlled Trial (RCT) from Turkey investigating educational tools for laparoscopic colorectal surgery showed that either the use of 3D animation and cadaveric videos individually or in combination, was a superior educational tool at helping candidates in understanding rectal surgery, compared to surgical textbooks (23). A summary of these studies on cadaveric dissection as training adjunct can be found in appendix I.

Animation and 3D techniques have also been reported in general surgical training literature. In a RCT comparing the educational role of three dimensional printed models with that of the conventional Magnetic Resonance Imaging (MRI) films in the training of surgical residents, residents who trained on three dimensional models performed better compared to those who relied only on MRI images (25). This has potential use in pre-operative planning and represents an additional educational tool which is very relevant in the modern context where there is limited recourse to cadavers and animal models for training. There is also evidence from meta-analysis of systematic reviews looking at the role of Video Based Coaching as a method of improving surgical training. In one study, 24 eligible RCTs were identified that showed that Video Based Coaching increased the technical performance of surgical residents performing jejunojejunostomy, right colectomy, and laparoscopic cholecystectomies, even though significant study and intervention heterogeneity was noted due to a wide range of Video Based Coaching techniques included (26). A summary of these studies on various adjuncts such as didactic as well as video based coaching and 3D models has been summarised in appendix II.

Within minimally invasive surgery, several studies have been conducted in general surgical specialties to assess and validate the use of modalities such as box simulation and virtual reality trainers. A comprehensive systematic review, including eighteen RCTs, by Humm et al. investigated the impact of virtual reality simulation training on operative performance in laparoscopic cholecystectomy. This study showed that virtual reality training, compared to no additional training, led to better junior trainee performance in performing a laparoscopic cholecystectomy measured by time to complete task and OSATS (27). A multicentre RCT amongst colorectal surgery trainees showed that surgical performance of trainee surgeons with different competencies in sigmoid colectomy was well differentiated using virtual reality simulators. Competency gained on the virtual simulator also translated to real life surgical competency with significantly improved performance through repetition for time, movements, and path length for less experienced surgeons (28). A summary of these studies on various virtual and augmented reality simulation adjuncts and their role in surgical skills training has been summarised in appendix III.

There is good evidence for a 'Train the trainer' program for colorectal surgery where laparoscopic surgery was introduced systematically through training the trainers, feedback, standardised assessment and incentivisation for laparoscopic surgery (29). The IMAGINE trial evaluates this approach in Australian gynaecologists, using a surgical outreach training model whose results are awaited. Results of this trial, if positive, is likely to be have a significant impact on training approaches within gynaecological oncology (30). In summary, there is a clear case for adapting and evaluating adjuncts and pedagogical research identified in other surgical disciplines to gynaecological oncology training.

Evidence for Laparoscopy Training in Gynaecological Oncology

There is some literature describing the evolution and use of laparoscopy amongst gynaecological oncology trainees in the USA. Frumovitz et al in a series of longitudinal surveys of American gynaecological fellows demonstrated an increased utility and role of this modality in modern gynaecological cancer care

(31,32). Laparoscopy forms the basis of minimally invasive surgery and lies at the intersection between open surgical techniques and the robotic assisted gynaecological procedures.

Even though laparoscopy is now widely employed in the field of gynaecological oncology, our scoping literature search did not find evidence on how best to train trainees in the acquisition of laparoscopic skills. There is however some evidence regarding the validity and reliability of laparoscopy simulation training in general surgery and general gynaecology which can be extrapolated to infer its potential usefulness in gynaecological oncology training.

An overview of the various simulation models shows that generally, simulation models are associated with shorter operative time and fewer intraoperative errors in vivo (8,17). There is considerable literature reviewing the evidence behind simulation based training, using common modalities such as laparoscopic box trainers, laparoscopic virtual reality simulator, animal models and lightly embalmed human cadavers (17). These support simulation training modalities and identify augmented reality with haptic feedback as the highest fidelity modality followed by virtual reality simulators (33,34). The Royal College of Obstetricians and Gynaecologists training curriculum for benign gynaecology now includes laparoscopic virtual simulation, whilst a number of gynaecological subspecialty training programs in the USA have already incorporated laparoscopic simulation training as a standard part of their curriculum (7,35).

Avenues for further development of this subject include establishing the evidence for laparoscopic skills training in gynaecological oncology via RCTs and subsequent integration of simulation skills training into the training curriculum (20). It will be important to establish the evidence for the construct and predictive validity as well as the reliability of virtual simulation in gynaecological oncology training before integration into the training curriculum. This is due to the highly specialised nature of gynaecological oncology which may not guarantee direct inference from the evidence and experience in general gynaecology and other surgical specialties.

Alternative Modalities in Training

Our literature search identified several training augmentation tools which have been reported as useful, both within the UK and internationally. The two most discussed modalities of gynaecological oncology surgical training include the use of cadaveric models and low-cost virtual reality simulation.

Cadaveric dissection

The use of human and animal cadaveric dissection for surgical training is a well-established training method. Porcine wet laboratory training in laparotomy, small bowel resection, splenectomy, hepatectomy, amongst other surgical procedures, has been shown to improve surgical proficiency (24). Feedback from the use of cadaveric models for training in highly complex procedures has further demonstrated its usefulness (36). Sideris et al. aimed to evaluate a new postgraduate training course for cytoreductive surgery for advanced ovarian/fallopian tube or primary peritoneal cancer using thiel-embalmed cadavers. This course had consultant surgeons with backgrounds in upper gastrointestinal, colorectal, hepatobiliary and urological surgery as trainers. Feedback from trainees concluded that the use of surgical experts within a cadaveric training course was invaluable in enhancing gynaecological oncology surgical training, especially due to the multi-organ/system approach required within these procedures (37).

Researchers from Istanbul described two cadaveric courses held in 2019, for vulva cancer surgery and abdominal gynaecological cancer surgery. Participant feedback described an improvement in surgical skills, technique development and understanding of topographic surgical anatomy (38). This supports the use of cadaveric dissection alongside clinical training. However, though widely used, this is expensive, limited in access and hard to scale.

Virtual Reality Simulation

In Zambia, low-cost virtual reality radical hysterectomy training was demonstrated to increase trainees' confidence, enhance skill development and reinforce anatomical and clinical knowledge. Within this training, participants were trained to perform five sequential steps of a radical abdominal hysterectomy on a virtual reality platform constructed to scale, enabling manipulation with equivalent instruments and visual feedback, but no haptic feedback (39). These methods could reduce the time and cost needed to teach trainees Wertheim's surgical techniques and hence, could be arguably beneficial in both high-income and resource-limited settings. Larson et al. showed a 17 – 50 % reduction in operative time with virtual reality training compared to traditional methods or no training, with greater proficiency achieved with more complex procedures (21).

Indeed, the challenges related to providing adequate evidence-based training, through training adjuncts like simulation training, for gynaecological oncology trainees exists in the context of huge training disparities world-wide as well as within the same country. Some of these training methods will need adaptation to ensure that they are useful in high income countries as well as low- and middle-income countries. Hence, it is important to examine the evidence very broadly, but also with the knowledge of the disparities in training curricula and requirements in different health systems.

Global overview of gynaecological oncology training programs

The need for formal gynaecological oncology training programs has come to the forefront in many low- and middle-income countries due to a rising burden of gynaecological cancers in these settings. Amongst the cohort of these countries with gynaecological oncology training, we recognise notable differences in training infrastructure. There are multiple challenges such as the lack of local human resource and infrastructure which hamper the establishment of a modern gynaecological oncology subspecialty training which is comprehensive and of comparable international standards of academia and professionalism (40,41).

In many low- and middle-income countries, gynaecological oncology training programs have been achieved through effective collaborative work between local and international partners. There are mainly two types of gynaecological training in this cohort of countries; formal subspecialisation, accredited locally, nationally or internationally through foreign universities or entities such as the International Gynaecological Cancer Society (IGCS) (40–42) as well as special training in the acquisition of gynaecological oncology skills outside formal subspecialty training. of a formal subspecialty program. Gynaecological cancer care is within the remit of general surgeons who have different skillsets in some countries, such as Brazil. This is relevant within the current debate regarding the scope of surgical training in gynaecological oncology. (41). Gynaecological cancer in the hands of general surgeons may reflect an underdevelopment of gynaecological oncology as a subspecialty in these settings and this has implications for continuity care and the stewardship of holistic care.

United Kingdom

Gynaecological Oncology training in the UK is an established program of 2- or 3-year duration pending evidence of research exemption at time of application. It is a national, Royal College of Obstetricians & Gynaecologists structured training program with entry based on years of training criteria and an interview process. An online logbook of surgical and non-surgical competencies is required to be maintained. There is no exit exam; however, there is an annual progress review conducted in the form of a panel which evaluates workplace-based assessments such as Objective Structured Assessment of Technical Skills, Case-Based Discussions, and mini-Clinical Evaluation Exercise. Research criteria for completion of training includes a higher degree (Doctor of Medicine (MD) or PhD), two first-author original research publication or an advanced professional module in clinical research (43).

The Royal College of Obstetricians and Gynaecologists subspecialty training program in gynaecological oncology supports the majority of training within the UK. However, a small number of UK centres are also European Society of Gynaecological Oncology accredited centres. The European Society of

Gynaecological Oncology provides an alternative structured training curriculum which has been adopted by the majority of Europe with over 163 accredited centres across the UK, Europe and the USA (44).

Europe

The European Society of Gynaecological Oncology has formulated a standardised training curriculum for trainees, which has included a minimum number of surgical procedures directly related to a gynaecological cancer diagnosis. All objectives and educational requirements within the European Society Gynaecological Oncology curriculum have been created through the Delphi method (iterative expert analysis of popular opinions and salient points via questionnaires), with a strong focus on trainee involvement. To obtain accreditation, the trainee must complete all qualitative and quantitative objectives and sit a written exit exam (44).

United States

Gynaecological oncology fellowship programs are certified by the Accreditation Council for Graduate Medical Education. The program enables individuals to demonstrate proficiency in a diverse spectrum of surgical procedures, as outlined by the American Board of Obstetrics and Gynaecology. Upon completion, the trainee is eligible to take the American Board of Obstetrics & Gynaecology oral and written examinations for Board Certification in gynaecological oncology (45).

Australia

The Certification in Gynaecological oncology Subspecialty Committee in Australia has the authority to oversee the training and accreditation policies for the attainment of the gynaecological oncology subspecialty. This includes a three-year scheme with compulsory rotations, reports, work-based assessments, a prospectively approved research project, multi-source feedback and a written examination. All these training requirements must be met, with certification by the Royal Australian and New Zealand College of Obstetricians and Gynaecologists board (46).

International Gynaecologic Cancer Society

In December, 2016 the IGCS introduced the gynaecological oncology global curriculum and mentorship program, a two year program created for countries in low and middle income settings without formal gynaecological oncology training to augment education and training.

The organisation leveraged existing infrastructure and collaborations to create a harmonised program for subspecialty training in the management of gynaecological cancer in low- and middle-income countries through the twinning of training institutions in developing and developed countries. Existing relationships and infrastructures such as virtual multidisciplinary teams are used to deliver virtual training alongside hands-on training, ongoing matrices and evaluation, and a final examination with a certificate of completion of training. Fellows keep a logbook through RedCap which can be regularly reviewed by local and international faculty. The Global Curriculum and mentoring scheme has centres in Bahamas, Ethiopia, Fiji, Guatemala, Jamaica, Kenya, Mozambique, Uganda and Zambia (42).

Gynaecological Oncology Programs in Africa

South Africa

The gynaecological oncology subspecialty training program in Africa started in 2008. It is a two-year program with the knowledge-based component assessed through an exit examination and clinical competency assessed through a logbook system. The program has a formal research requirement in the form of completion of a research project (47). The program is accredited by the Health Professions Council of South Africa, Medical and Dental Professions Board (48).

Kenya

The training program curriculum in Kenya was developed through the Canadian Society of Gynaecologic Cancer with Moi University responsible for the accreditation of the training program. In 2017, this program became one of the pilot sites for the IGCS training initiative and was subsequently absorbed into the IGCS global curriculum (40).

Ghana

Ghana has a long-standing residency program in Obstetrics & Gynaecology established in 1989 between the University of Michigan and the Teaching Hospitals of Ghana. It is off the foundations of this residency program that subsequent training in gynaecological oncology and other gynaecological subspecialties was established. Their 4-year program in gynaecological oncology has very specific entry requirements with a comprehensive syllabus covering every aspect of medical and surgical oncology including radiation therapy and pathology. Clinical assessment is through quarterly assessment of the trainees logbook whilst knowledge exam is through the two part Fellow of West African College of Surgeons (FWACS) examination . The is also a research requirement. The program is accredited by the Ghana College of Physicians and Surgeons (GCPS) benefits from a modest support from the University of Michigan which has a long-standing relationship with the Ghana College of Physicians and Surgeons (41,49).

Ethiopia

The maiden program at the Black Lions Hospital in 2013 was a 3-year program. This was followed by the program at St Paul's Hospital Millennium Medical College in 2015, both under the accreditation of the University of Addis Ababa and subsequently also accredited by the Association of Gynaecological Oncology, Germany (41). Both programs have now been absorbed into the IGCS Global Curriculum and Mentoring scheme as one of its pilot sites (42).

Central America, Oceania & Latin America

The first initiative towards providing specialised care for women in Central America came through - The Central America Gynaecologic Oncology Education Program - a training program designed to reinforce aspects of gynaecological oncology training amongst residents in Obstetrics & Gynaecology in Central America as opposed to a formal subspecialisation program. The Central America Gynaecologic Oncology Education Program was developed through a collaboration with the IGCS and American College of Obstetricians & Gynaecologist and interested residency

programs in Central America. It was initially launched in Guatemala in 2009 but has since expanded to include Honduras, El Salvador, Nicaragua, Panama and Costa Rica. (41).

In Latin America, like most other low- and middle-income settings, care for women with cancers is being provided by general obstetricians and gynaecologists with a limited number of formal training programs for the gynaecological oncologist (50). Brazil offers training in surgical oncology, following which trainees are able to manage other cancers as well as those in women (41).

Indian subcontinent

India

There is an established 3-year subspecialty training program with specific entry criteria. Progress is monitored by the trainee's local institution, with local mentors responsible for training. There is an exit exam which assesses the knowledge based aspect of training (51).

Pakistan

Gynaecological oncology as an independent subspecialty is a relatively new program in Pakistan. So far it has been included as part of surgical oncology training, which is an established course (52).

A separate gynaecological oncology fellowship is currently being offered as a 2-year fellowship with an entry requirement of 4 years of work experience in Obstetrics & Gynaecology and a basic post graduate qualification; this is being offered by the Aga Khan University. Entry is based on an interview (53).

Nepal

Nepal does not have any formal gynaecological oncology training programs. As there is a strong need for trained gynecological oncologists to provide care, there is a 2 year Global Curriculum and mentorship program designed by IGCS to provide support and training until a program can be established (42).

Bangladesh

There is a fellowship program of up to 3 years which candidates are eligible for following completion of basic postgraduate qualifications, with the requirement of an exit exam as well as thesis submission if opting to complete the academic portion of the curriculum (1 year) (54).

Sri Lanka

Sri Lanka has a well-established curriculum for gynaecological oncology training. Candidates are eligible following completion of their post-graduate qualifications. There is no entrance examination, entry being based on their performance at their Doctor of Medicine/Master of Science examination. The program is for a duration of 3 years with 2 years of local training and 1 year of overseas training followed by an exit assessment to become board certified in gynaecological oncology (55).

South-East Asia

There are 24 gynaecological oncology training centres spread out over Indonesia, Malaysia, Singapore, and Thailand; however, the level of training differs across all centres based on local factors (41).

Singapore

Singapore offers a 12-month fellowship open to all candidates, including international ones, pending an application and interview process. There is a well-established curriculum with assessments at regular intervals but no exit examination (41).

Indonesia

There is a recently established subspecialty training program in the form of a 2-year fellowship offered to Gynaecologists in Indonesia. Entry is based on a screening process with an exit examination at the end of the fellowship (56).

Malaysia

Gynaecological oncology is now an established structured training program of 3 years in Malaysia with an entry criterion and an exit certification. There is an option to spend some portion of their training overseas (57).

Thailand

Thailand has a 2-year structured subspecialty training curriculum for candidates who have completed their core residency training in Obstetrics & Gynaecology Entry is based on a competitive interview with an exit examination comprising a written and oral examination to be certified as a Gynaecological Oncologist (58).

One common characteristic noted throughout the review of training programs is that there is no standardisation on the objective assessment of surgical competencies at entry or at the end of gynaecological oncology training or fellowships. Although trainees may be assessed based on performance at an exit examination, oral vivas or satisfactory evidence of completion of course requirements based on logbook and review panel recommendations; it is not evident from the curricula that there are standardized or objective approaches to assess surgical competencies at the end of the curriculum.

Finally, it is worth noting that the aforementioned challenges in training may also represent the evolution of gynaecological oncology as a specialty. This may warrant a change in training requirements as well as a change in training strategies as the job description of the modern gynaecological oncologist evolves. Training programs will need to accommodate a trend towards greater centralisation and higher volume centres offering treatment for gynaecological cancer. Even within high volume centres, there may be teams that specialise in ovarian cancer surgery or teams that specialise in robotic surgery. In some settings, there may be a shift towards team working with other specialities such as colorectal surgeons, which will influence the requirements for training.

Conclusion

Our review finds that that there is no standardization of skills assessment or optimal best practice for how to train trainees to operate in gynaecological oncology surgical procedures. There are a wide range of training programs in gynaecological oncology across the world reflecting the needs of the individual healthcare systems. Several potential solutions including: cadaveric dissection, simulation training, use of virtual reality and 3D model printing exist, but are yet to be thoroughly validated with high quality evidence lacking for any of these 'trainee focussed' interventions, particularly in gynaecological oncology surgery. Similar underlying issues with the transfer of surgical skills in trainees in other surgical specialities exist and ongoing research is noted. Most of this work has been done in general surgery and will need adapting to gynaecological oncology trainees who usually receive training in Obstetrics and Gynaecology prior to gynaecological oncology training; robust evaluations of these are needed as future research priorities.

Currently, the evidence to support any interventions is generally of low quality and none have evaluated transfer to clinical environments or sustained impact on skills. Any intervention that improves surgical skills also needs to demonstrate translation to real-world performance and have a meaningful impact on clinical outcomes (reduced operative times, greater independence in operating, no excess morbidity). Validation of these methods before their systematic and formal introduction into training curriculums is warranted.

Consensus to agree on surrogate endpoints and how these can be measured in a standardised way will be critical to adoption into routine training. Basket trials evaluating training interventions conducted to an agreed protocol across multiple countries, including trainees and trainers from diverse skill sets and countries of differing income categories, are critical to generate high quality evidence on augmenting surgical training in gynaecological oncology. This will ensure that future gynaecological oncologists are best placed to deliver the safest possible surgical outcomes and improved cancer care for patients.

References

1. Vergote I, Coens C, Nankivell M, Kristensen GB, Parmar MKB, Ehlen T, et al. Neoadjuvant chemotherapy versus debulking surgery in advanced tubo-ovarian cancers: pooled analysis of individual patient data from the EORTC 55971 and CHORUS trials. Lancet Oncol. 2018 Dec;19(12):1680–7.

2. Chiofalo B, Bruni S, Certelli C, Sperduti I, Baiocco E, Vizza E. Primary debulking surgery vs. interval debulking surgery for advanced ovarian cancer: review of the literature and meta-analysis. Minerva Med. 2019 Aug;110(4):330–40.

3. Pesola F, Sasieni P. Impact of screening on cervical cancer incidence in England: a time trend analysis. BMJ Open. 2019 Jan;9(1):e026292.

4. Falcaro M, Castañon A, Ndlela B, Checchi M, Soldan K, Lopez-Bernal J, et al. The effects of the national HPV vaccination programme in England, UK, on cervical cancer and grade 3 cervical intraepithelial neoplasia incidence: a register-based observational study. The Lancet. 2021 Dec 4;398(10316):2084–92.

5. Lycke KD, Kahlert J, Damgaard R, Mogensen O, Hammer A. Trends in Hysterectomy Incidence Rates During 2000-2015 in Denmark: Shifting from Abdominal to Minimally Invasive Surgical Procedures. Clin Epidemiol. 2021;13:407–16.

6. Hoffman MS, Chi DS, Clarke-Pearson DL, Cliby W, Creasman W, Underwood PB. Surgical training in gynecologic oncology: Past, present, future. Gynecol Oncol. 2020 Jul;158(1):188–93.

7. Roque DR, Hinchcliff E, Alter R, Barber EL, Marcus J, Tanner E. Surgical Training in Gynecologic Oncology: A Sea Change. J Gynecol Surg. 2022 Dec;38(6):393–6.

8. Bryant-Smith A, Rymer J, Holland T, Brincat M. 'Perfect practice makes perfect': the role of laparoscopic simulation training in modern gynaecological training. Obstet Gynaecol. 2020;22(1):69–74.

9. Manchanda R, Oxley S, Ghaem-Maghami S, Sundar S. COVID-19 and the impact on gynecologic cancer care. Int J Gynecol Obstet. 2021;155(S1):94–101.

10. Hopkins Tanne J. United States limits resident physicians to 80 hour working week. BMJ. 2003 Mar 1;326(7387):468.

11. Pärgmäe P, Martins N, Rodríguez D, Christopoulos P, Werner HMJ. European Working Time Directive: Implementation across Europe and consequences upon training in obstetrics and gynaecology. Facts Views Vis ObGyn. 2011;3(1):46–50.

12. Hays RT, Jacobs JW, Prince C, Salas E. Flight Simulator Training Effectiveness: A Meta-Analysis. Mil Psychol. 1992 Jun;4(2):63–74.

13. Arora V, Somashekhar S p. Essential surgical skills for a gynecologic oncologist. Int J Gynecol Obstet. 2018;143(S2):118–30.

14. Gan C, Bossart M, Piek J, Halaska M, Haidopoulos D, Zapardiel I, et al. Robotic and Advanced Laparoscopic Surgical Training in European Gynecological Oncology Trainees. Int J Gynecol Cancer. 2017 Feb;27(2):375–81.

15. Bizzarri N, Pletnev A, Razumova Z, et al. Quality of training in cervical cancer radical surgery: a survey from the European Network of Young Gynaecologic Oncologists (ENYGO). Int J Gynecol Cancer. 32:494–501.

16. Bric JD, Lumbard DC, Frelich MJ, Gould JC. Current state of virtual reality simulation in robotic surgery training: a review. Surg Endosc. 2016 Jun 1;30(6):2169–78.

17. Varras M, Nikiteas N, Varra V, Varra F, Georgiou E, Loukas C. Role of laparoscopic simulators in the development and assessment of laparoscopic surgical skills in laparoscopic surgery and gynecology (Review). World Acad Sci J. 2020 Mar 17;2.

18. Ng Peng Yun, Bing Eric G, Cuevas Anthony, Aggarwal Ajay, Chi Benjamin, Sundar Sudha, Mwanahamuntu Mulindi, Mutebi Miriam, Sullivan Richard, Parham Groesbeck P (2023) Virtual reality and surgical oncology ecancer 17 1525.

19. Shore EM, Grantcharov TP, Husslein H, Shirreff L, Dedy NJ, McDermott CD, et al. Validating a standardized laparoscopy curriculum for gynecology residents: a randomized controlled trial. Am J Obstet Gynecol. 2016 Aug 1;215(2):204.e1-204.e11.

20. Burden C, Oestergaard J, Larsen C. Integration of laparoscopic virtual-reality simulation into gynaecology training. BJOG Int J Obstet Gynaecol. 2011;118(s3):5–10.

21. Larsen CR, Oestergaard J, Ottesen BS, Soerensen JL. The efficacy of virtual reality simulation training in laparoscopy: a systematic review of randomized trials. Acta Obstet Gynecol Scand. 2012 Sep;91(9):1015–28.

22. Lefor AK, Harada K, Kawahira H, Mitsuishi M. The effect of simulator fidelity on procedure skill training: a literature review. Int J Med Educ. 2020 May 18;11:97–106.

23. Benlice C, Elcircevi A, Kutlu B, Dogan CD, Acar HI, Kuzu MA. Comparison of textbook versus three-dimensional animation versus cadaveric training videos in teaching laparoscopic rectal surgery: a prospective randomized trial. Colorectal Dis Off J Assoc Coloproctology G B Irel. 2022 Aug;24(8):1007–14.

24. Selcuk İ, Tatar I, Huri E. Cadaveric anatomy and dissection in surgical training. Turk J Obstet Gynecol. 2019 Mar;16(1):72–5.

25. Bangeas P, Drevelegas K, Agorastou C, Tzounis L, Chorti A, Paramythiotis D, et al. Three-dimensional printing as an educational tool in colorectal surgery. Front Biosci-Elite. 2019 Jan 1;11(1):29–37.

26. Augestad KM, Butt K, Ignjatovic D, Keller DS, Kiran R. Video-based coaching in surgical education: a systematic review and meta-analysis. Surg Endosc. 2020 Feb;34(2):521–35.

27. Humm G, Mohan H, Fleming C, Harries R, Wood C, Dawas K, et al. The impact of virtual reality simulation training on operative performance in laparoscopic cholecystectomy: meta-analysis of randomized clinical trials. BJS Open. 2022 Jul 18;6(4):zrac086.

28. Beyer-Berjot L, Berdah S, Hashimoto DA, Darzi A, Aggarwal R. A Virtual Reality Training Curriculum for Laparoscopic Colorectal Surgery. J Surg Educ. 2016 Nov 1;73(6):932–41.

29. Mackenzie H, Cuming T, Miskovic D, Wyles SM, Langsford L, Anderson J, et al. Design, Delivery, and Validation of a Trainer Curriculum for the National Laparoscopic Colorectal Training Program in England. Ann Surg. 2015 Jan;261(1):149–56.

30. Obermair A, Armfield NR, Graves N, Gebski V, Hanna GB, Coleman MG, et al. How to train practising gynaecologists in total laparoscopic hysterectomy: protocol for the stepped-wedge IMAGINE trial. BMJ Open. 2019 May 1;9(5):e027155.

31. Frumovitz M, Soliman PT, Greer M, Schmeler KM, Moroney J, Bodurka DC, et al. Laparoscopy training in gynecologic oncology fellowship programs. Gynecol Oncol. 2008 Nov;111(2):197–201.

32. Frumovitz M, Ramirez PT, Greer M, Gregurich MA, Wolf J, Bodurka DC, et al. Laparoscopic training and practice in gynecologic oncology among Society of Gynecologic Oncologists members and fellows-in-training. Gynecol Oncol. 2004 Sep 1;94(3):746–53.

33. Botden SMBI, Buzink SN, Schijven MP, Jakimowicz JJ. Augmented versus virtual reality laparoscopic simulation: what is the difference? A comparison of the ProMIS augmented reality laparoscopic simulator versus LapSim virtual reality laparoscopic simulator. World J Surg. 2007 Apr;31(4):764–72.

34. Postema RR, van Gastel LA, Hardon SF, Bonjer HJ, Horeman T. Haptic exploration improves performance of a laparoscopic training task. Surg Endosc. 2021 Aug 1;35(8):4175–82.

35. RCOG [Internet]. [cited 2023 Mar 15]. ATSMs. Available from: https://www.rcog.org.uk/careers-and-training/training/curriculum/atsms/

36. Lim CP, Roberts M, Chalhoub T, Waugh J, Delegate L. Cadaveric surgery in core gynaecology training: a feasibility study. Gynecol Surg. 2018;15(1):4.

37. Sideris M, Elshaer AM, Johnson RL, Kotwal S, Mehta S, Quyn A, et al. 'Learning from the experts' - a novel advanced cadaveric course for Gynaecological Oncology (GO) Cytoreductive Surgery. Facts Views Vis ObGyn. 2022 Sep;14(3):265–73.

38. Selçuk İ, Barut Ç, Çalişkan E. Impact of a gynecologic oncology cadaveric dissection course for surgical training. Anatomy. 2019 Apr 1;13(1):56–60.

39. Bing EG, Brown ML, Cuevas A, Sullivan R, Parham GP. User Experience With Low-Cost Virtual Reality Cancer Surgery Simulation in an African Setting. JCO Glob Oncol. 2021 Mar;7:435–42.

40. Rosen B, Itsura P, Tonui P, Covens A, van Lonkhuijzen L, Orang'o EO. Development of a comprehensive and sustainable gynecologic oncology training program in western Kenya, a low resource setting. Gynecol Oncol Rep. 2017 Aug;21:122–7.

41. Johnston C, Ng JS, Manchanda R, Tsunoda AT, Chuang L. Variations in gynecologic oncology training in low (LIC) and middle income (MIC) countries (LMICs): Common efforts and challenges. Gynecol Oncol Rep. 2017 May 1;20:9–14.

42. IGCS [Internet]. [cited 2022 Dec 5]. Global Curriculum & Mentorship Program. Available from: https://igcs.org/mentorship-and-training/global-curriculum/

43. RCOG [Internet]. [cited 2022 Dec 6]. Subspecialty training curriculum. Available from: https://www.rcog.org.uk/careers-and-training/training/curriculum/subspecialty-training-curriculum/

44. ESGO - European Society of Gynaecological Oncology [Internet]. [cited 2023 Sep 7]. Fellowship Training in Gynaecological Oncology. Available from: https://esgo.org/fellowship-training-in-gynaecological-oncology/

45. MD Anderson Cancer Center. Gynecologic Oncology Fellowship. [cited 2022 Nov 28]. Gynecologic Oncology Fellowship. Available from: https://www.mdanderson.org/education-training/clinical-research-training/graduate-medical-education/residencies-fellowships/gynecologic-oncology.html

46. RANZCOG. Training Program Handbook - Certification in Gynaecological Oncology. The Royal Australian and New Zealand College of Obstetricians and Gynaecologists; 2022.

47. The Colleges of Medicine of South Africa: Sub-specialty Certificate in Gynaecological Oncology of the College of Obstetricians and Gynaecologists of South Africa [Internet]. [cited 2023 Sep 28]. Available from: https://www.cmsa.co.za/view_exam.aspx?QualificationID=86

48. Snyman L. Meeting future requirements in gynaecological oncology subspecialty training. South Afr J Gynaecol Oncol. 2012 Jan;4(2):48–9.

49. Klufio CA, Kwawukume EY, Danso KA, Sciarra JJ, Johnson T. Ghana postgraduate obstetrics/gynecology collaborative residency training program: success story and model for Africa. Am J Obstet Gynecol. 2003 Sep 1;189(3):692–6.

50. Chuang L, Berek J, Randall T, McCormack M, Schmeler K, Manchanda R, et al. Collaborations in gynecologic oncology education and research in low- and middle- income countries: Current status, barriers and opportunities. Gynecol Oncol Rep. 2018 Jun 9;25:65–9.

51. Ram TS, Thomas V, Sathyamurthy A, Ramireddy JK, John NO, Thomas A, et al. Training for next-generation gynaecologic surgical & radiation oncologists - opportunities & challenges. Indian J Med Res. 2021 Aug;154(2):338–45.

52. Shaukat Khanum Memorial Cancer Hospital & Research Centre » Surgical Oncology at SKMCH&RC, Lahore [Internet]. [cited 2022 Dec 5]. Available from: https://shaukatkhanum.org.pk/surgical-oncology-lahore/

53. Fellowship-Gynaecologic Oncology | MC, Pakistan | The Aga Khan University [Internet]. [cited 2022 Dec 5]. Available from: https://www.aku.edu/mcpk/fellowship/Pages/gynaecologic-oncology.aspx

54. Research and Training. Bangladesh College of Physicians & Surgeons (BCPS). [Internet]. Available from: https://bcps.edu.bd/

55. PGIM [Internet]. [cited 2022 Dec 5]. Available from: https://pgim.cmb.ac.lk/post-md-subspecialty-training-and-board-certification-in-gynaecological-oncology-medicine/

56. Tjokroprawiro BA. Gynecologic oncology fellowship in Indonesia. Int J Gynecol Cancer. 2021 Jul;31(7):1085–6.

57. Yusoff Z bt. mgcs. [cited 2023 Sep 7]. History of Gynaecological Oncology in Malaysia. Available from: https://www.themgcs.com/history-of-gynae-onco

58. Chinthakanan O. Department of Obstetrics and Gynecology Faculty of Medicine Chiang Mai University. 2010 [cited 2023 Sep 7]. Followship Training. Available from: https://w1.med.cmu.ac.th/obgyn/gynecology-oncology/overview/1285/

Appendix I