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Are, C., Berman, R.S., Wyld, L. et al. (3 more authors) (2016) Global Curriculum in Surgical Oncology. Annals of Surgical Oncology, 23 (6). pp. 1782-1795. ISSN 1068-9265

https://doi.org/10.1245/s10434-016-5239-7

Global Curriculum in Surgical Oncology

I. INTRODUCTION:

The global cancer burden is expected to increase significantly over the next few decades. Worldwide in 2012 there were 14.1 million new cancer cases, 8.2 million cancer-related deaths and 32.6 million people living with cancer within five years of diagnosis.[1] It is predicted that by the year 2035 there will be 23.9 million new cancer cases and 14.6 million cancer-related deaths.[1] (Figure 1)

The distribution of global cancer burden is and will continue to be very uneven with the majority afflicting the less developed regions of the world. In 2012, 5.3 million (65%) new cancer cases and 15.6 million (48%) cancer-related deaths (15.6 million- 48%) occurred in the less developed regions of the world.[1] Similarly, by 2035, 14.7 million (61%) new cancer cases and 10.3 million (70%) cancer-related deaths will occur in the less developed regions of the world.[1]

Nearly 80% of cancer patients will need surgical intervention at some time and by the year 2030 it is estimated that 45 million surgical procedures will be required annually.[2] It is well known that the majority of patients with a cancer diagnosis do not have ready access to safe and or affordable cancer surgery. [2],[3] The failure to provide adequate cancer surgery can lead to a loss of US $ 6.2 trillion in cumulative worldwide gross domestic product by 2030.[2] While the causes are multi-factorial, one factor impeding access to safe and affordable cancer surgery is the paucity of surgeons who are trained and educated in the management of patients with varying cancer diagnoses.

The ability to develop a sustainably adequate surgical oncology workforce depends on the presence of robust educational systems that promote training in all oncologic domains and also help in maintaining competency for those in clinical practice. Undoubtedly, there are significant differences in cancer burden, cancer types, resource-availability, oncologic management and even in the definition of oncologic workforce in different parts of the world. However, the fight against cancer is global and any effort aimed at finding uniformity in the global management of cancer would be of tremendous benefit to the world-wide community. We believe that this starts with generating broad uniform guidelines on the training and maintenance of competency for surgical oncology professionals.

There are several barriers to cancer care ranging from lack of cancer awareness and cultural barriers to presentation, lack of affordable basic population health care provisions, dearth of adequate facilities and inadequate number of trained personnel. Whilst it is inevitable that in certain countries inadequate training may be just one of many complex factors acting as barriers to adequate cancer care, having a globally accepted gold standard for minimal training in surgical oncology will help to disseminate best practice and raise global average standards of care and reduce inequalities.

The aim of this position statement is to build on and harmonize our previous respective society training curriculae and requirements [4-6] and thereby to provide a foundational scaffolding for essential and common requirements for training surgical oncology professionals. The authors are

aware that the training of surgical oncologists worldwide is extremely variable[7] and provide a broad schema of the training pathway. (Figure 2) The position statement is not intended to mandate specific content for training for each region or country of the world. It is hoped that this scaffolding of essential requirements will be used as an aspirational framework upon which to make modifications to suit the needs of the specific region or country of the world in the future. It is deliberately designed to be modular and flexible to permit adaptation to the disease burden variations and the cultural and health economic realities of diverse countries. The authors are deeply aware of the diverse barriers to education in different parts of the world based on the socio-cultural, geo-political and financial constraints. Hence the paper does not purport to be all encompassing but instead focuses on the salient aspects of training that are essential to be incorporated into the training curriculum of a surgical oncologist. A summary of the curriculum is depicted in Table 1.

II. CORE DOMAINS OF GENERAL ONCOLOGY FOR THE SURGICAL ONCOLOGIST:

A surgical oncologist is an oncologist who also possesses the expertise to perform operative procedures and interventions. As such, every surgical oncologist should possess the required knowledge of the basic principles and tenets of oncology. These are outlined below.

1. **The epidemiology of cancer which should include:**
    a. A good understanding of the current and future global cancer burden and a detailed understanding of the cancer demography of the surgeons' own specialist area of practice in their geographical location.
    b. Knowledge of the temporal trends in cancer incidence rates and the underlying causes and their likely impact on service provision.
    c. A good understanding of all modifiable and fixed risk factors and how these may be used to determine cancer risk in an individual patient.
    d. Should be able to provide individual and population advice in risk reduction strategies.
2. **Principles of screening for cancer which should include:**
    a. Awareness of the essential criteria of Wilson and Junger[8] for effective screening, (1968), the types in use both globally and in their geographic area and the evidence on which their efficacy is based.
    b. Knowledge of the risks and benefits of screening in terms of screening harms and over-diagnosis, health economic issues (at both national and international levels) and a critical appreciation of the various biases associated with screening data interpretation which make judging its efficacy so challenging (lead time bias, length bias etc)[9].
    c. An understanding of the various types of screening that should include those of proven efficacy: breast, cervical, colorectal and gastric as well as those where efficacy is uncertain and trials are in progress: prostate, lung and ovarian cancer.
3. **Principles of chemotherapy for cancer management which should include:**

a. A basic understanding of the general mechanism of action of key chemotherapy agents and their side effects, risks, benefits, indications for use and duration of administration in the neo-adjuvant/adjuvant and metastatic and palliative settings.
b. Knowledge of how to sequence chemotherapy with other treatment options such as surgery and radiation therapy.
c. Knowledge of the influence of chemotherapy on outcomes of subsequently performed operative procedures.
d. Knowledge of the principles underlying single agent regimens or poly-chemotherapy with established criteria to assess response to chemotherapy (response evaluation criteria in solid tumours, RECIST etc [10]).
e. Awareness of the side effects and how they may be managed (for example neutropenic sepsis and the role of colony granulocyte stimulating factor and antibiotic therapy).
f. A good understanding of the methodological issues involved in chemotherapy trial design and reporting to enable new trial data to be critically evaluated.

4. **Principles of radiation therapy for cancer management which should include:**
    a. An understanding of the different modalities of radiation (protons, gamma, beta and alpha particles) and the different modes of delivery, (external beam, intensity modulated radiotherapy (IMRT), tomotherapy, brachytherapy, stereotactic radiosurgery and radiopharmaceuticals).
    b. Knowledge of how to sequence radiation therapy with other treatment options such as surgery and chemotherapy.
    c. Knowledge of the risks, benefits, indications for use and duration of administration in different cancer types in the neoadjuvant/adjuvant and the metastatic and palliative settings.
    d. An understanding of the biological basis of radiation induced cytotoxicity, and the barriers and facilitators to efficacy (radiosensitisers, hypoxia).
    e. Knowledge of the acute and longer term side effects such as acute inflammation, chronic radiation fibrosis and secondary cancer development (for example the risk of angiosarcoma) and endarteritis obliterans.
    f. Understanding of the impact of radiotherapy on the technical aspects of the proposed operative procedure and its subsequent morbidity (wound healing/dehiscence, fibrosis etc).
5. **Principles of the biologic and immunologic basis of cancer management and control which should include:**
    a. This should include an understanding of the newer biological agents and targeted therapies.
    b. Understanding the basic principles of monoclonal and small molecular targeting agents and the principles behind their specificity in a particular cancer (e.g. Her-2 over expression in breast cancer, K-ras in colorectal cancer etc).

c. Knowledge of basic principles of immunotherapy (immune editing etc), novel immune-therapeutic agents including check-point inhibitors, their indications, combination strategies and their therapeutic potential.
d. Knowledge of the health economic implications of these agents and how this must be taken into account by health care funders.
e. Awareness of the common side effects of these agents.

6. **Principles of chronic pain management for cancer patients which should include:**
   a. Knowledge and applied skills in the use of commonly prescribed oral, systemic and topical analgesics and management of untoward side effects.
   b. Knowledge of variations in pain management depending on the clinical setting (curative versus palliative).
   c. Knowledge of side-effects of commonly used analgesics and their management.
   d. Awareness of the 'analgesic ladder' (proposed by the World Health Organization[11]) ranging from mild analgesics to strong opiates and the use of alternative analgesics and adjuncts such as anti-inflammatories, agents that are active against neuropathic pain, synthetic cannabinoids and muscle relaxants.
   e. Awareness of the role of local/regional blocks and other interventional procedures (intra-thecal pain pumps, radiofrequency ablation etc) and their indications and contraindications.
   f. Knowledge of the use and efficacy of transcutaneous electrical nerve stimulation, (TENS), acupuncture and other region-specific modalities to treat pain.
7. **Principles of palliative care for cancer management which should include:**
   a. An deep understanding of end of life care and advance directives, living wills, psychological support, bereavement support and the phases of bereavement.
   b. Knowledge of palliative symptom control (anti-emetics, anti-diarhoeals, laxatives, appetite stimulants, nutritional support, management of pain, dyspnea, cough, xerostomia, excessive oral and pharyngeal secretions, fever, anxiety, insomnia, delirium, palliative sedation at end of life and palliative surgery (for example for relief of biliary or ureteric obstruction) and steroids to reduce cancer related oedema (liver metastases, brain metastases).
   c. Knowledge of the use of palliative chemotherapy and radiotherapy and the delicate balance between symptom palliation and treatment side effects (Quality adjusted time without symptoms or toxicity, Q-TWIST[12]).
   d. Ability to coordinate care with multiple teams and family members to lead end-of-life discussions
8. **Principles of medical imaging for cancer management which should include:**
   a. Knowledge of the various radiological modalities (Ultrasound, CT, MRI, PET CT etc) and their basic functioning principles.

b. Knowledge of adequate staging protocols (organ-specific protocols with multiple phases) for the main cancer types and the indications for each imaging modality in cancer assessment and operative planning.
c. Knowledge of the indications for radiological imaging in cancer surveillance.
d. Awareness of the use of imaging intra-operatively for margin assessment and cancer localization.
e. Knowledge of the methods used to analyze pre-operative imaging to help with operative decision making (stereotactic localization etc).
f. Knowledge of the use of interventional radiology in cancer care such as stent placement, radiotherapy, cryotherapy and high frequency ultrasound targeting, therapeutic vascular embolization and chemotherapy delivery.
g. Awareness of novel imaging modalities (example: choline PET scan etc).
h. Awareness of adverse effects associated with excessive or unwarranted imaging

9. **Principles of multi-disciplinary cancer management which should include**:
    a. An understanding of the importance of the multi-disciplinary team (MDT) in the management of cancer. Optimal outcomes are delivered by multimodal therapy regimes which mandate that cancer decision making should be undertaken by a multidisciplinary team comprising a core membership of surgeon, pathologist, radiologist, oncologists and patient advocate.
    b. At the basic level, a MDT should help in confirming the diagnosis of cancer by checking concordance between the clinical, radiological and pathological findings before treatment commences.
    c. Knowledge of how to develop and implement efficient MDT's for malignancies involving various organ systems.
10. **Principles of diagnostic pathology for cancer management which should include:**
    a. Understand the role of the pathologist as part of the multidisciplinary team. The surgical oncologist should have a working knowledge of the following concepts: surgical specimen orientation, margin assessment, specimen preservation, standard pathology reporting and terminology, interpretation of frozen section reports and impact on operative planning, immunohistochemistry, genetic analysis techniques such as fluorescence in situ hybridization (FISH) and polymerase chain reaction (PCR) and more complex multigene array technologies.
    b. Knowledge of specimen procurement for analytical and research purposes.
    c. Knowledge of the importance of pathology in both prognosis calculation (and use of prognostic scoring algorithms) and in determining tumour molecular phenotype to guide targeted therapies (e.g. Her-2 receptor status in breast cancer, K-ras status in colorectal cancer, c-kit in gastrointestinal stromal tumours, GIST).
    d. Proficient knowledge of the commonly used pathologic staging systems for various cancers, such as the Tumour, Nodes, Metastases system (TNM) [13].
11. **Principles of surveillance for cancer management which should include:**

a. Knowledge of post-treatment surveillance protocols for different tumour types, algorithms, frequency and the evidence for benefit

12. **Principles of cancer biology which should include:**
    a. This should include a basic understanding of the 'hallmarks of cancer' (Hanahan and Wienberg, [14, 15]) and the processes that are key to cancer development and progression (angiogenesis, unregulated proliferation, telomere function, apoptosis, cell cycle regulation, defective DNA repair mechanisms, tumour initiation, promotion, migration and metastasis).
    b. Knowledge of the key oncogenes and tumour suppressor genes known to be implicated in the process of oncogenesis (tp53, ras, myc etc). Knudson's two hit hypothesis[16].
    c. Understanding the role of hereditary factors in carcinogenesis and the key cancer syndromes (BRCA, Li Fraumeni syndrome, APC, HNPCC, e cadherin etc).
13. **Principles of research into cancer which should include:**
    a. An understanding of basic science research, translational research, investigating new targets for cancer therapy research, epidemiology research, cancer burden research, disparities research, cohort and case control study design and their indications and potential limitations, randomized trial design and quality standards, psycho-oncology research and research into quality of life issues.
    b. An understanding of the basic and (optionally) advanced statistical methods is essential to conduct research and also permit critical evaluation of research.
14. **Principles of delivering cancer care across all resource settings which should include:**
    i. A basic understanding of the health care expenditure for the world and for their specific region or country.
    ii. The influence of resources (public and private) on the ability to deliver comprehensive cancer care.
    iii. Awareness of the influence of government policy and regulations on maintaining sustainable resources for delivering cancer care.
    iv. Awareness of the limitations arising out of lack of resources and the ability to tailor care suitable to all resource settings of the world.
15. **Hereditary cancer syndromes and their management:**
    a. Knowledge of the role hereditary predisposition plays in the development of many cancer subtypes.
    b. Knowledge of management ranging from, weak predisposing genetic variants such as single nucleotide polymorphisms (SNPs), moderate risk genes where specific testing may be appropriate combined with targeted surveillance protocols and lastly potent genetic mutations, usually of key tumour suppressor genes (such as BRCA1 and 2, APC, HNPCC, tp53 etc), where not only targeted surveillance may be offered but risk reducing surgery may be appropriate.

c. Understanding the impact of these genes both in terms of risk estimation for an individual without cancer and the impact of these mutations in a patient with cancer on their treatment options and long term management.
d. Knowledge of the broad indications for gene testing for at risk families.
e. Familiarity with genetic risk calculation tools and algorithms for different cancer types.

III. CORE DOMAINS IN PRE, PERI AND POST-OPERATIVE SURGICAL CARE FOR THE SURGICAL ONCOLOGIST:

The surgical oncologist should be technically proficient in the art, science and principles of surgical procedures. This should enable the surgical oncologist to perform surgical procedures when indicated in a safe fashion to deliver high value care with good quality outcomes. The surgical oncologist should therefore possess the required knowledge and skill of the basic principles and tenets of simple and complex oncological procedures. It should be emphasized that surgical care for oncology patients is provided by a wide variety of professionals with equally divergent training backgrounds. While in some countries surgical oncology training follows general surgery training, in some other surgical cancer care is delivered by general surgeons with no further training. Although some of the mentioned domains may be adequately addressed through general surgery training in some countries or redundant for surgical oncology training in countries with fellowships, the purpose of including these reflects what the finished product should be competent in regardless of the training pathway. These are outlined below:

1. **Principles of surgical procedures and techniques which include:**
    a. Knowledge of the basic and complex surgical procedures for treating malignancies of various organ systems
    b. Knowledge of the principles of clinically relevant anatomy applicable to surgical procedures
    c. Knowledge of the extent of resection for primary lesions and metastatic lesions
    d. Knowledge of the appropriate extent of lymphadenectomy ranging from nodal sampling, sentinel node biopsy and different levels of lymphadenectomy for various cancers
    e. An understanding of how to assess margins and different levels of adequacy (R0, R1 and R2)
    f. Knowledge of the role of debulking surgery
    g. Awareness of the differences in the management between curative intent versus palliative intent surgery
    h. An understanding of the balance between oncologic adequacy versus minimizing morbidity and function preservation of oncological procedures.

2. **Principles of various surgical approaches for cancer surgery**. It has to be emphasized that the competence in this domain will be entirely dependent on the availability of resources which eventually determines the availability of the surgical equipment and required operative skills. Competence may be expected in resource-rich environments, whereas an awareness of the techniques is desirable in resource-poor settings. While technology may be available it should be evaluated in the context of each country and its resources ensuring that a good oncologic procedure can be performed even by the open approach.
    a. Competence in principles of open surgical procedures
    b. Awareness or competence in principles of minimal access procedures where applicable
    c. Awareness or competence in principles of restorative, reconstructive and oncoplastic surgery where applicable
    d. Awareness or competence in principles of endoscopic procedures where applicable
    e. Awareness or competence in principles of robotic surgery where applicable
    f. Awareness or competence of natural orifice surgery and other novel techniques where applicable
    g. Awareness or competence in principles of interventional procedures where applicable.
    h. Awareness or competence in principles of ablation (radio frequency, microwave, cryoablation), irreversible electrophoresis etc.
    i. Awareness of newer technologies and the ability to assimilate them into practice where circumstances and resources permit.
3. **Principles of patient selection for cancer surgery which should include:**
    a. Ability to select patient's for surgical procedures based on appropriate indications
    b. More importantly the ability to avoid surgical procedures in patients where the benefits are not evident
4. **Principles of risk stratification prior to surgical procedures which should include**:
    a. Knowledge of how to balance risks and benefits of any proposed procedure
    b. Knowledge of some of the objective tools available to balance the risks and benefits prior to any surgical procedure (ACS NSQIP risk calculator[17], nomograms [18], regionally available quality metrics and tools etc).
    c. Knowledge of assessment of functional status based on objective tools (Karnofsky etc)
    d. Knowledge of subjective assessment of functional status
    e. Knowledge of how to combine objective and subjective assessments to reach conclusions on the risk/benefit profile for each procedure.
5. **Principles of operative planning based on staging/pre-operative imaging and preparation which should include:**
    a. Knowledge of how to tailor operative procedures based on variations in pre-operative staging and imaging.

b. Knowledge of how to tailor procedures based on functional status of patient.
c. Awareness of pre-operative preparation such as bowel prep, when to stop anti-coagulation etc

6. **Principles of obtaining consent for operative procedures which should include:**
    a. Knowledge of how to consent that is informed and compassionate that can lead to shared-decision making.
    b. Ability to tailor discussions based on the complexity of the procedure.
    c. Knowledge of how to discuss the risks/benefits and pros/cons of not only operative procedures but also the alternatives to surgery.
7. **Principles of intra-operative care which should include**:
    a. Knowledge of how to manage intra-operative complications such as the difficult airway, difficult venous access etc.
    b. Knowledge of how to manage intra-operative consequences such as carcinoid crisis, parathyroid crisis, thyrotoxic crisis etc.
    c. Knowledge of basic patho-physiological derangements such as haemodynamic instability requiring vasopressors, increasing airway pressures, bleeding diathesis etc.
    d. Knowledge of protocols to prevent intra-operative adverse events such as hypothermia, burns etc.
    e. Ability to work collaboratively with the pathologist to interpret intra-operative frozen sections and make appropriate decisions
    f. Ability to work collaboratively with anesthesiology to provide effective team care.
8. **Principles of post-operative care which should include**:
    a. Awareness of major and minor post-operative complications.
    b. Awareness of frequency and time-frames of post-operative complications.
    c. Knowledge of how to prevent, diagnose and treat post-operative complications.
    d. Knowledge of commonly used preventative measures such as those to address deep venous thrombosis, stress ulcers etc.
    e. Knowledge of administration of post-operative antibiotics, duration, type and combination regimens
    f. Knowledge of how to treat complications such as deep venous thrombosis etc in the context of fresh post-operative state.
    g. Knowledge of commonly used tools to quantify post-operative complications (Clavien Dindo system [19], International Study Group of Pancreatic Fistula, Common terminology for adverse events, (v4.0 CTCAE [20]).
    h. Knowledge of how to manage drains, ostomies, feeding tubes etc in the post-operative period.
    i. Knowledge of how to manage post-operative pain with combinations of systemic, oral, spinal, regional or other modalities.

j. Ability to coordinate post-operative care with multiple providers ranging from nursing, physiotherapy, occupational therapy, speech therapy, palliative care etc
k. Knowledge of the local systems to help in discharge planning either to home or skilled nursing facility
l. Ability to lead discussions with the patient and their family to discuss prognosis based on pathological staging and determining further treatment options.

9. Principles of post-operative critical care which should include:

a. Awareness of hemodynamic monitoring with basic knowledge of vasopressor agents
b. Awareness of managing an intubated patient with basic knowledge of various ventilator modes, weaning modes and criteria for extubation.
c. Knowledge of monitoring fluid status, resuscitation and the risks/benefits of various colloids and crystalloid administration.
d. Awareness and expertise regarding nutritional support needs and routes in the pre, peri and post-operative period.

IV. ESSENTIALS OF CORE KNOWLEDGE DOMAINS OF SURGICAL ONCOLOGY FOR EACH SPECIFIC DISEASE SITE:

A surgical oncologist should possess in-depth knowledge of malignancies involving each specific disease site. These are outlined below:

1. Breast:

a) Breast imaging and image guided biopsy
b) Benign breast disease
c) High risk breast disease
d) Breast cancer
    - In situ
    - Invasive
    - Locally advanced

v. Uncommon breast tumors
vi. Metastatic disease
vii. Genetics in breast cancer
viii. Surgical breast procedures
    - Partial mastectomy
        - Wire localization
        - Radioactive seed localization
    - Total mastectomy
    - Reconstruction options
    - Lymph node staging

ix. Multidisciplinary management

2. Colorectal and anal cancer:

a. Colon Cancer
- Screening

b. Rectal Cancer
- Screening
- Adenocarcinoma
- Locally advanced
- Other (Neuroendocrine,GIST)

c. Anal Cancer
- Squamous Cell
- Melanoma

d. Appendiceal
- Adenocarcinoma
- Carcinoid
- Disseminated peritoneal adenomucinosis (DPAM or pseudomyxoma peritonei)

e. Colorectal Cancer Syndromes
- Polypoid, non-polypoid, other

f. Procedural- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)
- Colon- segmental, subtotal
- Rectal
  - Low anastomosis (low anterior resection, coloanal anastomosis)
  - Abdominoperineal resection
  - Transanal excision/microsurgery (TEMS if feasible and appropriate)
- Anal
- Pelvic exenteration
- Cytoreduction/ Cytoreduction plus hyperthermic intraperitoneal chemoperfusion (HIPEC if feasible and appropriate)

3. Esophagus, gastric and GE junction:

i. Esophagus
- Adenocarcinoma
- Squamous Cell Carcinoma
- GIST

ii. Stomach
- Adenocarcinoma

- GIST
- Carcinoid
- Hereditary diffuse gastric cancer (HDGC)
- Gastric lymphoma

iii. Esophageal Resection- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)

- Transhiatal
- Ivor Lewis
- McKeown three stage esophagectomy

iv. Gastric Resection- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)

- Distal gastrectomy
- Total gastrectomy
- Partial/wedge gastrectomy
- Lymphadenectomy (at minimum D1 and D2)

v. Staging- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)

- Washings/cytology

4. Small intestine:

a) Adenocarcinoma
b) Carcinoid
c) Upper GI polyps- syndrome related and sporadic
d) Small bowel resection plus regional lymphadenectomy- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)
e) Radical duodenal (pancreatic-preserving) resection- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)
f) Splenectomy for hematologic malignancy or metastatic disease- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)

5. Pancreas:

a. Adenocarcinoma
b. Neuroendocrine
c. Cystic neoplasms (Mucinous, Serous, Solid and papillary epithelial)
d. Benign pancreatic disease
e. Other
g. Secondary, Lymphoma, heterotopia
h. Resection procedures- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)

- Pancreaticoduodenectomy
- Distal, subtotal, central, total
- Enucleation,

- Ampullary resection

i. Palliative procedures- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate) - Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)
   - Bypass and stenting

i. Diagnostic
   - Intraoperative ultrasound
   - ERCP

6. Liver and Biliary Tract:

a. Liver tumors
   - Benign
   - Malignant
     - Hepatocellular carcinoma
     - Secondary hepatic
     - Sarcoma

b. Biliary tumors
   - Choledochal cysts
   - Pseudotumors
     - Stricture
     - Pancreatitis
     - Mirizzi's syndrome
   - Gallbladder cancer
   - Cholangiocarcinoma

c. Liver Procedures - Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)
   - Biopsy and ultrasound
   - Major hepatectomy (segmentectomy, lobectomy, hemihepatectomy, caudate)
   - Non-anatomic hepatic resection
   - Ablation of liver lesions
   - Transplantation (where feasible)

d. Biliary tract procedures- Open, Minimally Invasive (Laparoscopic/Robotic if feasible and appropriate)
   - Radical cholecystectomy with portal lymphadenectomy
   - Extrahepatic biliary ductal resection
   - Liver-directed therapies (where feasible)
     - Transcatheter arterial chemoembolization (TACE)
     - Other

7. Endocrine:

a. Thyroid mass

- Evaluation/Diagnosis
- Indications and extent of surgery
- Genetics
- Preoperative and postoperative management

b. Hyperparathyroidism

- Evaluation/Diagnosis
- Indications for surgery
- Genetics
- Preoperative and postoperative management

c. Adrenal mass

- Evaluation/Diagnosis
- Indications for surgery
- Genetics
- Preoperative and postoperative management

d. Thyroid surgery

- Thyroidectomy
- Central neck lymphadenectomy
- Lateral compartment lymphadenectomy

e. Parathyroid surgery

- Parathyroidectomy

a. Intraoperative PTH monitoring

- Exploration

f. Adrenalectomy

- Open
- MIS
  i. Laparoscopic (transabdominal/retroperitoneal)
  ii. Robotic

g. Neuroendocrine

8. Cutaneous Oncology:

a. Melanoma

- Primary
- Regional disease
  - Nodal
  - In-transit
- Metastatic

b. Non-melanoma pigmented lesions and atypical-spitzoid lesions
c. Merkel Cell Carcinoma
d. Non-melanoma skin cancer (including unusual cutaneous neoplasms)
e. Dermatofibrosarcoma Protuberans (DFSP)
f. Wide excision/closure/reconstruction options
g. Sentinel lymph node biopsy

h. Inguinal-Inguinopelvic lymphadenectomy
i. Axillary dissection
j. Modified radical neck dissection inclusive of parotidectomy
k. Popliteal and epitrochlear dissections
l. Isolated regional therapy (perfusion and infusion)

9. Sarcoma:

a. GIST
b. Retroperitoneal, pelvic, and abdominal visceral sarcoma
c. Extremity and trunk sarcoma
- Sarcomas with potential lymphatic spread
- Desmoid/aggressive fibromatosis
- Schwannoma/Malignant peripheral nerve sheath tumors
- DFSP-see cutaneous oncology

d. Bone sarcoma
e. Site-specific sarcoma
- Uterine
- Breast
- Head and neck
- Chest wall

f. Resections
- Limb salvage principles
- Wide excision
- Radical resection
- Amputations
- Isolated regional therapy (ILP and ILI)

g. Advanced sarcoma
i. Systemic/targeted therapy
ii. Surgery for metastatic disease

10. Peritoneal surface malignancies:
- Appendiceal
- Ovarian
- Pseudomyxoma peritoneii

11. Thoracic:

a. Esophageal- see Upper GI
b. Pulmonary
- Primary lung
- Metastatic disease

c. Mediastinal tumors and malignant pleural effusions
d. Procedural- Minimally invasive (thoracoscopic/laparoscopic, robotic) if feasible and appropriate
- Esophageal- see Upper GI

- Lung procedures
  - Resection metastatic disease
  - Wedge resection/segmentectomy/lobectomy
- Mediastinoscopy
- Thoracoabdominal resection

e. Diagnosis and management of Barrett's Esophagus
f. Palliative procedures

12. Genitourinary:

a. Renal cell carcinoma
b. Prostate cancer
c. Bladder cancer
d. Testicular cancer
e. Procedures - Minimally invasive (laparoscopic, robotic) if feasible and appropriate
i. Radical and partial nephrectomy
ii. Prostatectomy (as part of exenteration)

13. Other malignancies involving gynecological organs

14. Pathology:

a. Tumor processing

- Gross assessment
- Margin assessment
- Lymph node harvest and assessment
- Intraoperative assessment
- Frozen section
- Touch cytology preparations
- Sentinel node processing and assessment
- Cytopathology

V. ESSENTIAL TRAINING CORE COMPETENCIES THAT NEED TO BE SATISFIED:

1. Holistic patient care

A surgical oncologist should be able to provide patient care that is evidence-based, wholly compassionate and comprehensive to address all the multiple afflictions arising from the cancer diagnosis. The primary purpose of cancer care is to enhance the holistic well-being of the patient. Whilst the inevitable focus is on cure of the cancer, this must be dispensed in a way that preserves or enhances quality of life and the patient's physical and mental well-being. The basic tenet of cancer care should rely on "adding life to years and not years to life".

Surgical oncologists have a professional duty to maintain and continually update their expertise to enable them to offer patient care that maximizes beneficial outcomes within the limits of the health care environment in which they practice. Cancer patients are extremely vulnerable during their treatment phase and a surgical oncologist should be able to work with multidisciplinary teams to address the personal needs and preferences of patients when making treatment choices.

2. Medical knowledge

A surgical oncologist should possess the required medical knowledge that encompasses the entire spectrum ranging from aetiology, risk factors, diagnosis, treatment and surveillance. Medical knowledge is in a phase of rapid and sustained evolution with nearly 2 million scientific papers published annually. It is the obligation of the surgical oncologist to stay abreast of the current, new and novel knowledge domains. The surgical oncologist should strive to acquire knowledge of other specialties that comprise a multi-disciplinary team.

3. Professionalism

Professionalism is a holistic construct resting on the provision of delivering good care, demonstrating honesty, maintaining ethical standards, displaying respect and sensitivity to diverse cultures and serving as a good role model. The reputation of oneself and the profession must be maintained by working with the highest levels of probity and quality of care. The confidentiality of the patient must be respected at all times with reference to the national legal frameworks for data protection. The surgical oncologist must take responsibility for their actions and outcomes with honesty and a desire to continually improve, always putting the patient's needs first. Professionalism is not just the province of the individual surgeon but of the health care provider organization which has a duty to provide a professional working environment that supports these goals. [21]

4. Inter-professional team working and communication skills

The surgical oncologist should demonstrate the ability to work with multi-disciplinary teams that stretch across disciplines and professions in a respectful manner that foster positive team dynamics. The leading role of the Surgical Oncologist is based on a profound and respectful understanding of all involved professionals. The decision-making process will benefit from scientific knowledge, clinical experience and compassionate insight provided by the whole team.

The surgical oncologist should also possess communication skills that are based on empathy, openness and honesty. Excellent communication skills are required to not only communicate with other professionals but also patients and their family members. Communication with other professionals is based on equity, respect and sharing medical knowledge. Communication with families and relatives is based on honesty and the translation of complex medical knowledge into lay terminology to help with shared decision making. It is essential to acknowledge that communication is a two way process and the views and opinions of patients are respectfully incorporated in all key management decisions.

5. Experiential learning

The surgical oncologist should be able to learn from their own experiences and implement measures to improve outcomes. This starts with a critical assessment of their own outcomes, relative to nationally established benchmarks and implement individual or system-wide measures to address areas of deficiency.

Since Surgery is a craft discipline, learning from critical self- assessment cannot be accomplished solely in a didactic learning environment but requires hands on training. This may be provided within

the clinical environment with supervised training but also by use of simulation training which is especially valuable for the acquisition of early phase skills [22]. Unlike knowledge retention which is readily tested by written examination, higher level skills on Miller's Pyramid for the assessment of clinical competencies (knowledge, competence, performance, action[23]) require more complex methods of assessment such as OSCE type assessments and a range of work-place based assessments[24-26]. Training should not be based entirely around a time frame or minimum numbers- based system but on a competency based system.

In addition to a structured quality assured training program, outcomes must also be quality assured throughout a surgeon's career. Cancer units must have robust protocols which are updated regularly in line with national and international guidelines and these must be audited against, both at unit level and at surgeon level. This must not be done as part of a blame culture but as part of the process of constructive feedback to facilitate constant improvement. The role of audit or outcomes research in improving cancer care is widely proven to be effective in improving outcomes[27]

6. Systems based practice (focus on cost/value of health care delivery and quality and safety of health care delivery)

As the complexity of health care delivery has increased, a surgical oncologist must understand the different settings of health care ranging from individual practices, group practices, stand-alone clinics, community health care centers to academic centers and how they relate to the larger context of health care delivery for their respective region or nation.

The surgical oncologist should possess knowledge of the geo-political situation, social stability and health policies and regulations that can influence health care. In addition an understanding of the gross domestic product spent on health care and the costs of delivering patient care at an individual level is essential. All surgical oncologists must demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care. Some of the key steps are to coordinate patient care within the health care system, incorporate considerations of cost awareness and risk-benefit analysis in patient care, advocate for quality patient care and optimal patient care systems, work in inter-professional teams to enhance patient safety and improve the quality of patient care, participate in identifying system errors and implementing potential systems solutions.

7. Operative skills for surgical professionals

The surgical oncologist should possess technical skills to be able to perform operative procedures safely whilst adhering to the established oncologic principles and deliver acceptable peri-operative, short-term and long-term oncologic outcomes.

Embracing the "art of surgery" is a life-long process which rests on dedication, dexterity, intuition, and good tuition. With a rapidly growing number of new techniques and a mounting variety of innovative instrumentations, a dedicated Surgical Oncologist should constantly aim to update their operative skills and repertoire. This continuous process benefits from extensive reading of the rapidly evolving relevant literature, attending scientific meetings (either physical or virtual) and participation in skills-based workshops.

Hands-on learning is crucial to surgical practice: therefore surgeons are encouraged to visit expert colleagues who should be willing to share their advanced knowledge. Numerous fellowships are available to serve this purpose; the SSO and ESSO have established training programs and bursaries to facilitate and promote practical education.

8. Understanding of the Human/Compassionate side of Medicine applicable to all socio-economic and diverse cultural regions of the world

Medical and surgical practice are often associated to evidence-based standards and hard science in search of advanced cancer treatments. In reality, the practice of Surgical Oncology is both an art and a science: at the moment it represents the most effective practice of healing cancer patients. Patients are at the very center of the art of compassionate care when social interaction is combined with medical science.

Geographical, cultural, economic, religious and ethical issues may differ substantially and patients expectations vary accordingly. Treatment availability is distributed unevenly and so is cancer awareness and access to diagnostic/screening tests. Such differences should be taken into account when setting the foundation of a Surgical Oncology program. The mission of a Surgical Oncologist is focused on patient well-being within the context of his or her psychosocial environment.

VI. CONCLUSIONS AND FUTURE:

In summary, the aim of this position statement is to provide a foundational scaffolding of requirements for training surgical oncologist's globally. This curriculum is neither all-inclusive or all-encompassing and may not be equally applicable to all countries or regions of the world. It is likely that some modules of the curriculum could be redundant for some regions whereas some modules could be out of the reach or not applicable to others. The authors and their respective societies are acutely aware that the educational environment, training structure and pathways and regulations are extremely variable across the world. Similarly various social, cultural and economic factors can have a strong influence on the educational environment for surgical oncologists. Despite these enormous differences, the foundational requirements for training a surgical oncologist globally to provide optimal cancer care are uniform. It is therefore envisioned that this initial position statement will provide a flexible and modular scaffolding that can be tailored by individual countries or regions to train surgical oncologists that are suitable for practice in their local environment.

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