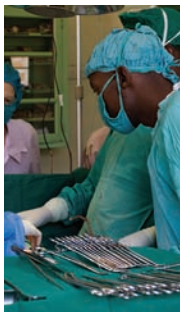

Chapter 13

Surgical Services for Cancer Care

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INTRODUCTION

Surgery is a fundamental modality for curative and palliative treatment of most cancers in countries across all income settings. In high-income countries (HICs), where the most common solid organ malignant cancers, such as breast and colon cancers, are more likely to be successfully diagnosed at early stages, surgical resection provides definitive locoregional control of the primary tumor. This approach has significant curative potential when combined with appropriately selected adjuvant systemic treatment and radiotherapy. In low- and middle-income countries (LMICs), where locally advanced or metastatic cancer is a common initial disease presentation, surgical resection or debulking may be one of the few available modalities to achieve reasonable palliative disease control.

Surgery has not received sufficient attention in the cancer control discussion in LMICs (Goss and others 2014; Purushotham, Lewison, and Sullivan 2012). With many competing health priorities and significant financial constraints, surgical services in these settings are given low priority within national health plans and are allocated few resources from domestic accounts or international development assistance programs (Bae, Groen, and Kushner 2011; Farmer and Kim 2008). As a result, in most low-income countries (LICs), and many middle-income countries (MICs), access to safe, optimal surgical services for cancer is poor, and large proportions of the population are unable to access even the most basic surgical care (Funk and others 2010).

The projected increase in the cancer burden in LMICs over the next 20 years (see chapter 2 in this volume) necessitates that all countries give consideration to the establishment of surgical services with adequate capacity to meet current and future needs. In general, significant capital investment in surgical infrastructure, equipment, and personnel is needed in LICs, especially those in Sub-Saharan Africa (LeBrun and others 2014). In MICs, improved coordination, regulation, financial risk protection, and strategic planning for cancer and surgical services are requisites to improve service delivery and outcomes (Goss and others 2014). Surgical capacity building takes time, particularly with respect to developing the surgical workforce. Efforts to strengthen surgical services in LMICs should be strategically proactive to facilitate the provision of safe, effective, and accessible surgical cancer care for current and future patients.

This chapter discusses the public sector delivery of surgical cancer services in resource-constrained environments. We describe the current status of surgical services for cancer care in LMICs, analyze the barriers to care, and outline the surgical delivery platforms available to countries at different resource and income levels. Key considerations for policy makers relating to quality, safety, access, coverage, and economic and planning considerations in the scale-up of surgical cancer services are highlighted.

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BURDEN OF SURGICALLY TREATABLE CANCERS IN LMICs

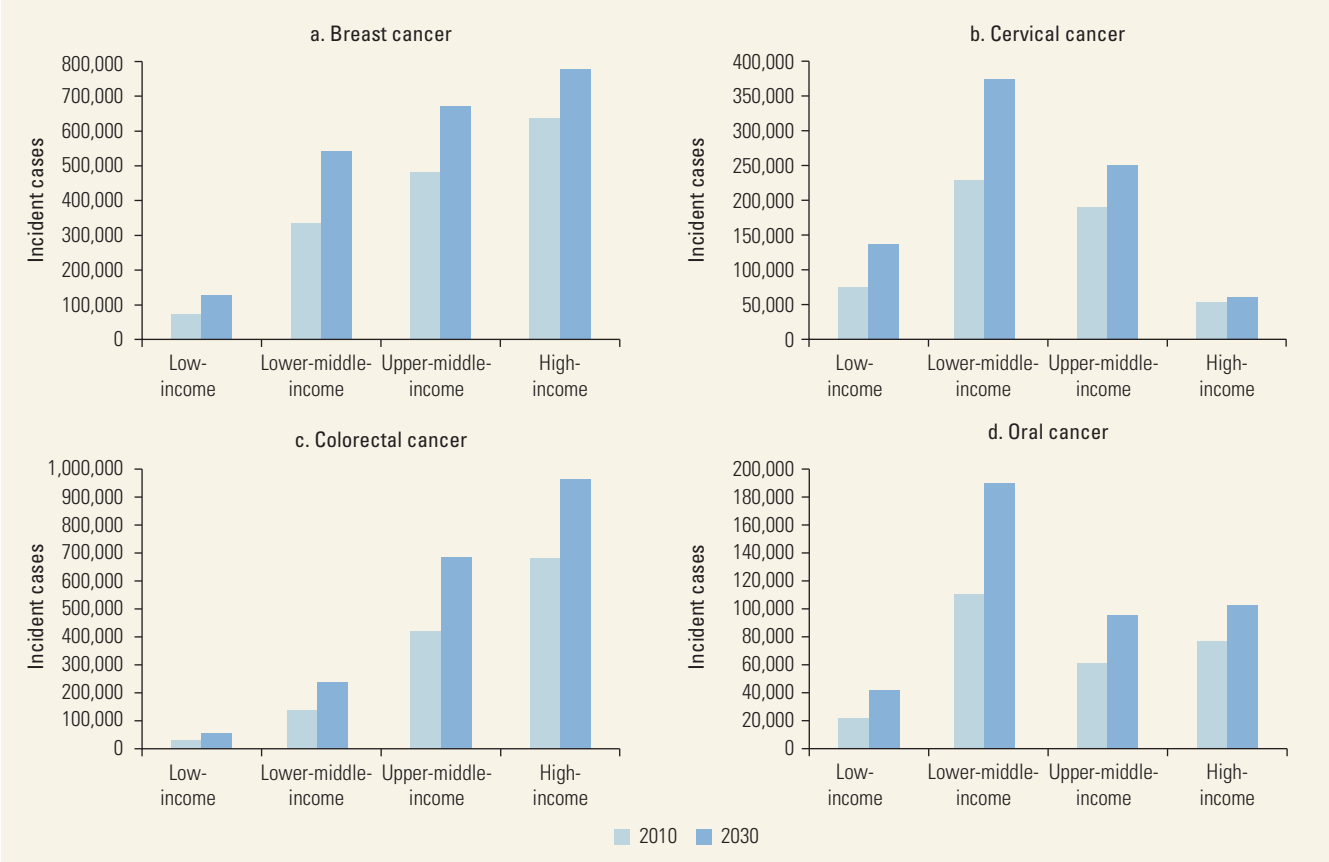
As many LMICs transition to higher levels of social and economic development, with attendant greater population growth and improved longevity, the cancer burden amenable to surgical treatment is projected to increase dramatically (figure 13.1). Almost all of the common cancers require surgical services for histological diagnosis if radiology-guided biopsy is not available, for resection as the mainstay of curative treatment, and selectively for palliation.

Surgery is more effective, less complex, and less costly when performed for early-stage or locally advanced cancer. Curative treatment can often be delivered within a single clinical encounter and is achievable even in low-resource settings. Although surgery has less of a role in advanced stage cancer, in select cases it can provide improved quality and prolongation of life, for example, for malignant bowel obstruction and fungating breast cancers. To realize the therapeutic benefit of surgical care in achieving cancer cure, stage-shifting is required to address the disease burden before it becomes locally advanced or metastatic—an objective particularly valid in LMICs, where more than 70 percent of patients present with advanced cancer (Adebamowo and Ajayi 2000; Anyanwu 2000, 2008).

STATUS OF SURGICAL CANCER SERVICES IN LMICs

The availability of, access to, and quality of surgical cancer care varies widely, leading to equally wide variations in outcomes among and within countries. Most LICs face profound shortages of surgeons, anesthesiologists, and pathologists; inadequate equipment and supplies; absent or severely dilapidated general and

Figure 13.1 Estimated Number of New Cancer Cases by Country-Income Group in LMICs for Four Common Surgically Treatable Cancers, 2010 and 2030



Source: Ferlay, Soerjomataram, and others 2013.
Note: All cases of breast, cervical, colorectal, and oral cancer require the input of a surgeon or gynecologist for diagnosis and clinical management. LMICs = low- and middle-income countries.

surgical infrastructure; and a lack of financing and strategic health services planning. The result is that a large proportion of the population is without access to even the most basic surgical services (Funk and others 2010; Weiser and others 2008). In most MICs, surgical services for cancer are more widely available, especially in major cities, but variations in quality, inequitable coverage and utilization, and poor central regulation and coordination (Pramesh and others 2014; Yip and others 2011) hamper the effective provision of care.

Access, Distribution, and Utilization

Access

Cancer surgery typically requires more complex infrastructure, training, support services, and referral networks than many basic surgical procedures. Gross inequities between HICs and LMICs exist in access to surgical services (Funk and others 2010; Weiser and others 2008) (table 13.1). An estimated two billion people lack access to any form of surgical care, including surgery for cancer (Funk and others 2010). Regional and national estimates of surgical services for cancer are not available, but access and coverage are likely to be significantly worse than for surgical services in general. Globally, approximately seven million to eight million patients require a major cancer operation each year, and at least three million additional patients require biopsies each year (Ferlay, Steliarova-Foucher, and others 2013).

Distribution

The distribution of surgical services within countries is also uneven in LMICs, compounding issues of access and coverage (Goss and others 2014). The surgical workforce and surgical facilities tend to cluster in urban areas (Ozgediz and others 2008). Surgical services for cancer, if present, typically are located at third-level facilities, often in the capital city, with poor or nonexistent referral networks. In settings in which a large proportion of the population lives in rural areas, accessing appropriate surgical cancer care can be an insurmountable challenge.

Utilization

Transportation costs and the time required to access diagnostic and treatment facilities may act as deterrents to receiving timely care. Even traveling relatively short distances can be a significant barrier in countries with poor transport infrastructure or challenging terrain. In a study of South African women presenting with breast cancer, the risk of presenting with an advanced stage cancer was 1.25 times higher for every 30 kilometers traveled to the diagnostic facility (Dickens and others 2014). In a situational analysis of health facilities in 24 LICs and 27 MICs, the average patient had to travel 100 kilometers to reach a facility that could perform a basic biopsy diagnostic procedure (Ilbawi, Cherian, Mikkelson, Sankaranarayanan, and Sullivan, unpublished data).

Even where surgical cancer services are available and accessible, prohibitive user costs and perceptions that cancer cannot be successfully treated may prevent people from obtaining timely treatment (Ilbawi, Einterz, and Nkusu 2013).

Sociocultural belief systems and practices can affect cancer awareness and the uptake of surgical cancer services in LMICs (Goss and others 2014). Barriers to timely uptake of services include fear of surgery and hospital services in general, "cancer fatalism," cultural beliefs and social stigma related to being cut or having a body part removed, poor community experiences relating to outcomes, and costs (Daher 2012; Goss and others 2014; Yip and Anderson 2007).

Quality, Safety, and Outcomes

Wide variations exist globally in the quality and safety of surgical care (see Debas and others 2015, chapter 16). Quality issues are particularly concerning in the context of surgical treatment for cancer, where achieving adequate resection is fundamental to the success of the procedure.

Infrastructure and Training

In LMICs, quality and safety issues are often closely linked to basic resource deficits relating to infrastructure,

Table 13.1 Disparities in Surgical Capacity between High-Income and Low-Income Countries

Measure	High-income countries	Low-income countries
Number of surgeons (Hoyler and others 2014)	34–97 per 100,000[a]	0.13–1.57 per 100,000
Number of anesthesiologists (Hoyler and others 2014)	34–97 per 100,000[a]	0–4.9 per 100,000
Number of operating rooms (Funk and others 2010)	> 14 per 100,000	< 2 per 100,000
Volume of operations[b] (Weiser and others 2008)	172.3 million procedures per year (73.6 percent of global total, for 30.2 percent of the global population)	8.1 million procedures per year (3.5 percent of global total, for 34.8 percent of the global population)

a. High-income country data refer to "surgical providers" and include surgeons and anesthesiologists within the same estimate.
b. Data refer to high-health-expenditure countries and low-health-expenditure countries, which are correlated with income status.

equipment, supplies, and sterility, as well as a lack of appropriately trained providers. Poor outcomes reinforce community perceptions that cancer cannot be successfully treated with surgery. Although lumpectomy and modified radical mastectomy for breast cancer are not technically complex procedures, inadequate surgical resection of tumors can significantly undermine the effectiveness of these procedures. Incomplete or inadequate breast cancer resection following lumpectomy or mastectomy has been reported at rates as high as 15–45 percent in India and Nigeria (Agarwal and others 2009; Thorat and others 2008; Ukwenya and others 2008); almost 50 percent of patients who underwent incomplete surgery in nonspecialist centers in India had surgically excisable disease left behind (Thorat and others 2008). Postgraduate training, which covers modern surgical oncology practices and continuing medical education, is lacking in many LMICs. This deficit impacts not only proper surgical oncology technique but also appropriate decision-making, including whether surgery is indicated.

Standardization of Guidelines

The standardization of surgical care with guidelines, standards, and checklists can ensure a minimum level of quality and safety and reduce avoidable surgical morbidity and mortality (Haynes and others 2009), even in resource-constrained settings (see Debas and others 2015, chapter 16). Current use of guidelines and standards for surgical care in LMICs varies among countries and facilities. A recent study of health facilities in 24 LICs and 27 MICs reported that only 22 percent of facilities (n = 294/1,269) had established clinical management guidelines for surgical care and pain relief (Ilbawi, Cherian, Mikkelson, Sankaranarayanan, and Sullivan, unpublished data). Most clinical guidelines have been developed in and for HICs and are not necessarily applicable in resource-poor settings. However, for the past decade, Tata Memorial Centre, a national comprehensive cancer center in Mumbai, India, has published its own clinical guidelines and algorithms for all aspects of cancer care, including surgical and perioperative care. The guidelines are developed and updated through annual evidence-based management meetings, using international evidence and taking into account local resources and challenges. Tata's guidelines (freely available for reference on their institutional website, https://tmc.gov.in/clinicalguidelines/clinical.htm) are now used in other LMICs, including Bangladesh, Kenya, and Nigeria. There is also an initiative to categorize some of these guidelines as "minimum," "optimal," and "optional," with health care delivery platforms treating patients based on the platforms' individual infrastructural and trained human resource capabilities.

Partners in the Provision of Surgical Services

The safe provision of anesthesia is another often overlooked requirement of effective surgical cancer care. Profound differences exist in anesthetic mortality rates between low and high Human Development Index countries (Bainbridge and others 2012); anesthetic mortality rates are reported to be as high as one in 500 in several LMICs in Sub-Saharan Africa (Glenshaw and Madzimbamuto 2005; Hansen, Gausi, and Merikebu 2000; Maman and others 2005; Walker and Wilson 2008; see Debas and others 2015, chapter 15.)

Cancer surgery is also highly dependent on two other major areas of clinical care: pathology and imaging. Quality pathology services are central to making an accurate diagnosis and planning appropriate surgical care. Imaging is required for accurately staging early, curable cancers; for planning more complex operative resections; and, in some cases, for establishing the presence of metastatic disease. The role of these services in the delivery of quality comprehensive cancer is discussed further in chapter 11 in this volume.

DEVELOPING SURGICAL CANCER SERVICES AND DELIVERY PLATFORMS IN LMICs

Resource-Stratified Approaches

Resource-stratified approaches to screening, diagnosis, and treatment interventions for specific cancers, which can help countries assess the level at which they can provide effective cancer services, have been presented in previous chapters. However, policy makers developing cancer control strategies need to consider not only what services are required, but also the platforms through which these services can be most effectively delivered to those who need them.

In this section, we outline potential delivery platforms for surgical cancer services in resource-poor settings, using a level-of-care approach (box 13.1). We consider how surgical cancer services—diagnostic, curative, palliative, and adjuvant services—may be effectively delivered across different surgical platforms (community health center, first-level hospital, or third-level hospital), using breast, cervical, oral, and bowel cancers as examples. Where relevant, we consider the most appropriate surgical platform for service delivery for countries at different income levels and according to the resource-stratified interventions presented in earlier chapters.[1] Finally, we discuss how quality and efficiency demands can be balanced with access and coverage challenges in LMICs through the appropriate deployment of surgical cancer platforms, and the referral networks and service partnerships between them. Many countries are

Box 13.1

Situational Analysis of Surgical Cancer Services: Key Questions

Key Questions for Policy Makers and Planners

- What is the burden of surgically treatable cancers in the country?
  - Current
  - Projected
- What stage of presentation is typical for each cancer (percent early, locally advanced, disseminated)?
- What surgical platforms are currently available within the country? Where are they located?
- Do any of these platforms currently provide surgical cancer care:
  - As part of a general surgical service?
  - As part of a dedicated cancer service?
- How well-resourced are these platforms?
  - Human resources, infrastructure, equipment, supporting services
- What adjuvant therapies are available and affordable for the country's resource level?
  - Where are these adjuvant therapies currently delivered, if anywhere?
  - Who delivers them?
- Are radiotherapy services available? Where?
  - Where are they available in relation to surgical and adjuvant treatment?
- Are palliative medicines, such as opioids, reliably available? Where?
- What referral networks exist? What are the barriers to referring patients between facilities?
- What are the barriers to receiving timely and appropriate surgical and cancer treatment?
  - Financial, geographic, sociocultural
  - Human resources, infrastructure, equipment and supplies
- Is it feasible to provide screening and early case detection, given the country's resource level and priorities?
  - Are there plans to do this in the medium-to-long term?
  - How will this affect surgical need?

only beginning to consider these issues; very little analysis or published country experience in LMICs is available to serve as an evidence base.

Guidelines for Surgical Platforms

Delivery platforms refer to the structural and organizational modes or channels of delivery for public health and clinical services. Platforms for delivery of surgical care can be defined across four levels:

- Community health center
- First-level hospital/district hospital
- Second-level hospital/regional hospital
- Third-level hospital/tertiary hospital

The basic resources required for each level are summarized in table 13.2. In practice, significant variations and overlap occur among levels of care.

Delivery platforms for surgical cancer services coexist with other platforms delivering general cancer and surgical services, inpatient services, and primary care. They are often co-located and operate synergistically to support the effective delivery of clusters of health services.

Diagnostic, Curative, and Palliative Services

Diagnosis Surgical services play a key role in cancer diagnosis. Biopsy, which is required for the definitive diagnosis of cancer, involves taking a sample of suspicious tissue by using either a needle or an open surgical technique and then examining the removed cells under a microscope. The tissue sampling aspects of the biopsy procedure can be provided in most LMICs within a first-level hospital platform, as well as higher platforms, if the surgical providers are trained in the technique used and adequate means for sample fixation exist. Providing biopsy services at a first-level platform reduces delays between initial presentation and definitive diagnosis and improves access and coverage. Because lymphadenopathy has many non-neoplastic causes in LMICs (Kingham and others 2013), referral to a higher specialist service for the purposes of tissue sampling only is premature, increases losses to follow-up, delays diagnosis, and risks overwhelming limited specialist services with nonspecific referrals.

Table 13.2 Platforms for Delivering Surgical Cancer Care

Community health center	District/first-level hospital	Regional/second-level hospital	Tertiary/third-level hospital
• Community health center or small rural hospital • May have a small number of inpatient and maternity beds • Capable of performing minor surgical procedures under local anesthesia • Paramedical staff, nurses, midwives • Visiting doctors	• District– or provincial-level hospital, with 50–300 beds • Adequately equipped major and minor operating theaters • Trained nonphysician or medical officer anesthetists • District medical officers in surgery, senior clinical (nonphysician) officers in surgery, nurses, midwives • +/– resident general surgeon and/or obstetrician-gynecologist • Visiting specialists	• Referral hospital of 200–800 beds • Well-equipped major and minor operating theaters • Supported by imaging, laboratory, and blood bank services, as well as basic intensive care facilities • Adequately equipped major and minor operating theaters • General surgeons, obstetrician-gynecologists • Anesthesiologists • +/– specialist surgeons	• Referral hospital of 300–1,500 beds • Well-equipped major and minor operating theaters • Advanced imaging, laboratory services • Intensive care facilities • Highly specialized staff and technical equipment • Clinical services highly differentiated by function • Often have teaching activities

Source: Adapted from WHO 2003 and Debas and others 2015, chapter 12.

Tissue sampling itself is not technically complex. Accurate and timely reporting of the biopsy sample by a trained pathologist is the main challenge in obtaining a diagnosis. In LICs, specimens may be taken at the first-level hospital level but processed and reported at a higher center, often within a third-level or national platform, because of the lack of trained histopathology technicians and pathologists. This approach can maximize available resources and also promote standardized, quality reporting. However, it requires coordination between the tissue sampling center, where the biopsy sample is taken, and the pathology center, where the biopsy is read and reported, to ensure timely feedback of the diagnosis.

In MICs, histopathology services may be more widely available, and basic pathology services may be provided within a first-level hospital platform. Centralized approaches to reading and reporting cancer biopsies are still important, however. These approaches can promote the efficient use of resources; increase the range of diagnostic tests able to be performed; and ensure standardized, quality reporting. For this reason, the use of second- or third-level platforms for biopsy reporting is encouraged.

Treatment with Curative Intent In LICs, surgical services for cancer are usually provided through second- or third-level platforms. Severe shortages of surgical infrastructure, equipment, surgeons, anesthesiologists, and supporting services preclude providing these services within a first-level platform. Cancer surgery is typically performed by generalist surgeons, as specialist cancer surgeons are not available.

In LICs with basic surgical resources at first-level facilities, a minimum package of surgical services for cancer can be delivered within this platform. This package includes biopsy, surgical treatment for precancerous cervical lesions and early-stage invasive cervical cancer, breast cancer surgery, and resection of small oral tumors (table 13.3). Provided there is a surgical provider familiar with cancer resection requirements, these procedures require little additional infrastructure, equipment, or supplies, compared with other major general surgical operations routinely performed at first-level facilities. Treatment of some precancerous lesions can be safely undertaken within a community or first-level platform, even where full general surgical services are not available. Rwanda has recently published its experience scaling up cervical screening and treatment services across the country using first-level or community-level facilities to screen, diagnose, and treat, often within a single clinical encounter (Binagwaho and others 2013).

In MICs, surgical services for early-stage breast, cervical, colon, and oral cancer can often be delivered within a first-level platform because of the greater availability of basic surgical resources, including surgeons. This delivery can improve access and may reduce the direct nonmedical costs associated with seeking surgical cancer care in many MICs. Appropriate training and continuing education of surgical providers at the first level is crucial, however, to reduce the risk of inadequate or incomplete resection.

Advanced breast, cervical, oral, and colorectal cancers require advanced surgical platforms in LMICs, typically a dedicated regional or national center providing cancer care. Advanced cancers are technically more

Table 13.3 Delivery Platforms for Priority Surgical Cancer Interventions in LICs and MICs

Intervention	Community health center	District (first-level) hospital	Regional (second-level) hospital	Tertiary (third-level) hospital
Breast cancer: LICs				
Diagnosis	Refer to higher center	Biopsy (send pathology to higher center)	Biopsy ± onsite pathology, imaging (XR, liver US), lab (CBC, LFT)	Biopsy + onsite pathology, imaging (XR, liver US), lab (CBC, LFT)
Curative surgical treatment	″	Referral to a higher center	MRM ± oophorectomy	MRM ± oophorectomy
Palliative surgical treatment	″	Referral to a higher center	Total mastectomy	Total mastectomy
Adjuvant therapy	″	Hormone therapy	Hormone therapy, chemotherapy	Hormone therapy, chemo, RT[a]
Breast cancer: MICs				
Diagnosis	Refer to higher center	FNA/US-guided FNAB, imaging (XR, liver US), lab (CBC, LFT)	FNA/US-guided FNAB + onsite pathology, imaging (XR, liver US), lab (CBC, LFT) BCS & SLNB (dye or radio[a,b])	FNA/US-guided FNAB + onsite pathology, imaging (XR, liver US), lab (CBC, LFT) BCS & SLNB (dye or radio[a,b])
Curative surgical treatment	″	MRM ± oophorectomy	MRM ± oophorectomy	MRM ± oophorectomy
Palliative surgical treatment	″	Total mastectomy	Total mastectomy	Total mastectomy
Adjuvant therapy	″	Hormone therapy, 1st-line chemo[b]	Hormone therapy, chemo, RT[a]	Hormone therapy, chemo, RT[a]
Cervical cancer: LICs				
Diagnosis	HPV test, VIA	HPV test, VIA	HPV test, VIA ± colposcopy, biopsy	HPV test, VIA ± colposcopy, biopsy
Curative surgical treatment				
Precancerous	Cryotherapy	Cryotherapy, LEEP	Cryotherapy, LEEP, cold knife	Cryotherapy, LEEP, cold knife
Invasive cancer	Refer to higher center	Refer to higher center	Simple and radical hysterectomy	Simple and radical hysterectomy
Palliative surgical treatment	″	″		
Adjuvant therapy	″	″	Chemo	Chemo, RT[a]
Cervical cancer: MICs				
Diagnosis	HPV test, VIA or cytology	HPV test, VIA or cytology, colposcopy, biopsy	HPV test, cytology, colposcopy, biopsy	HPV test, cytology, colposcopy, biopsy
Curative surgical treatment				
Precancerous	Cryotherapy	Cryotherapy, LEEP, cold knife	Cryotherapy, LEEP, cold knife	Cryotherapy, LEEP, cold knife
Invasive cancer	Refer to higher center	Simple hysterectomy; advanced cancer, refer to higher center	Simple and radical hysterectomy	Radical trachelectomy, hysterectomy, pelvic exenteration
Palliative surgical treatment	″			
Adjuvant therapy	″	Chemo[b]	Chemo, RT	Chemo, RT
Oral cancer: LICs				
Diagnosis	Refer to higher center	Biopsy	Biopsy + histopathology	Biopsy + histopathology
Curative surgical treatment	″	Resection of early-stage cancers	Resection of early and advanced	Resection of early and advanced
Palliative surgical treatment	″	Refer to higher center	For debulking/pain relief	For debulking/pain relief
Adjuvant therapy	″	″	RT[a] ± chemo	RT[a] ± chemo

table continues next page

Table 13.3 Delivery Platforms for Priority Surgical Cancer Interventions in LICs and MICs (continued)

Intervention	Community health center	District (first-level) hospital	Regional (second-level) hospital	Tertiary (third-level) hospital
Oral cancer: MICs				
Diagnosis	Refer to higher center	Biopsy	Biopsy + histopathology	Biopsy + histopathology
Curative surgical treatment	″	Resection of early-stage cancers	Resection of early and advanced ± oncoplastics	Resection of early and advanced ± oncoplastics
Palliative treatment	″	Refer to higher center	For debulking/pain relief	For debulking/pain relief
Adjuvant therapy	″	″	RT[a] ± chemo	RT[a] ± chemo
Colorectal cancer: LICs				
Diagnosis	Refer to higher center	gFOBT/FIT + referral for colonoscopy	Sigmoidoscopy/colonoscopy	Sigmoidoscopy/colonoscopy
Curative surgical treatment	″	Colectomy[b]	Colectomy, APR[b], LAR[b]	Colectomy, APR, LAR
Palliative surgical treatment	″	Colostomy for bowel obstruction	Colostomy for bowel obstruction	Colostomy for bowel obstruction
Adjuvant therapy	″	Refer to higher center	Chemo ± RT[a]	Chemo ± RT[a]
Colorectal cancer: MICs				
Diagnosis	FOBT + referral for colonoscopy	Colonoscopy + biopsy[b]	Colonoscopy + biopsy	Colonoscopy + biopsy
Curative surgical treatment	Refer to higher center	Colectomy	Colectomy, APR, LAR	Colectomy, APR, LAR
Palliative surgical treatment	″	Colostomy for bowel obstruction	Colostomy for bowel obstruction	Colostomy for bowel obstruction
Adjuvant therapy	″	Chemo[a,b]	Chemo ± RT	Chemo ± RT

Note: APR = abdominoperineal resection; BCS = breast-conserving surgery; CBC = complete blood count; FIT = fecal immunochemical test; FNA = fine needle aspiration; FNAB = fine-needle aspiration biopsy; FOBT = fecal occult blood test; gFOBT = guaiac fecal occult blood test; HPV = human papillomavirus; LAR = lower anterior resection; LEEP = loop electrocautery excision procedure; LFT = liver function test; LICs = low-income countries; MICs = middle-income countries; MRM = modified radical mastectomy; RT = radiotherapy; SLNB = sentinel lymph node biopsy; US = ultrasound; VIA = visual inspection of the cervix after acetic acid application; XR = x-ray; ± = with or without; ″ = repeats above.

a. If available within a country's resource level.

b. Provision at this level will be dependent on the availability of appropriate equipment, supplies, monitoring, and adequately trained providers.

complex to achieve adequate resection margins and wound closure. Platforms capable of delivering complex cancer and surgical care are often not available in LICs, especially outside the capital city. In addition to these priority cancers, other complex cancers (for example, musculoskeletal, thoracic, or hepatobiliary cancers) require surgical treatment within third-level platforms, usually by specialist surgeons.

Treatment with Palliative Intent Palliative surgery can significantly enhance the quality of life and allow patients to return home for end-of-life care. Palliative care for all patients with advanced-stage cancer hinges on access to appropriate analgesics, including opioids (see chapter 9). Surgery also has an important role in palliation, particularly in regions in which advanced presentations with very large, debilitating tumors are common. Palliative treatment should be provided within delivery platforms as close to patients' homes as possible.

Palliative surgical procedures commonly required in LMICs include mastectomy for bulky, fungating, or bleeding tumors and formation of a colostomy for obstructing colorectal tumors. In LICs, palliative colostomy formation or mastectomy can be performed within a second-level platform, or potentially at a first-level facility when resources permit. In MICs, most first-level platforms are equipped to provide this level of surgical care. Palliative surgical treatment must be undertaken cautiously. It should be made clear that the procedure is being done to improve the quality of life, rather than to extend it. Advanced disease has higher operative and postoperative risks; the risks and benefits of the procedure must be weighed carefully by providers and patients.

Adjuvant Treatment Considerations

Cancer treatment with surgery alone is only effective in early-stage disease. In resource-constrained settings, most patients tend to present with advanced disease, and

adjuvant therapy is usually required in addition to surgical resection. Strong coordination of surgical services and adjuvant services is needed to maximize outcomes, and additional considerations present with respect to the most appropriate surgical platform for patients who require both surgical care and adjuvant therapy.

In LMICs, platforms for basic surgical cancer care are likely to be more widely available than for adjuvant treatment, particularly radiotherapy. When planning cancer services, policy makers need to consider not only where surgical services are provided, but also how these are distributed in relation to where adjuvant therapy—including hormonal therapy, chemotherapy, radiotherapy, and biologics—can be provided. The availability of these services may dictate whether surgical treatment is appropriate and the type of intervention to be performed.

In many LMICs, the surgical providers are often responsible for prescribing and/or administering adjuvant therapy. This is very common when adjuvant endocrine therapy is required in the setting of breast cancer, for example, tamoxifen. Adjuvant chemotherapy is also often given by general surgeons, physicians, and even patients' families in LMICs. Ideally, chemotherapy should be delivered in a comprehensive cancer center by specialist staff within a second- or third-level platform to ensure appropriate, high-quality care. However, these stipulations place chemotherapy out of reach for many LICs. Where significant barriers exist to accessing chemotherapy and prevent uptake, preoperative or postoperative first-line chemotherapy can be administered by trained surgeons, general physicians, or nurses at first- or second-level hospitals, using clinical guidelines and management algorithms to guide treatment selection, if appropriate blood tests are available to monitor complications. Such polyskilling (where a provider is trained to deliver more than one type of cancer care) can be used to overcome human resource shortages and minimize referral delays.

The delivery of radiotherapy is limited by its availability; in all LICs and most MICs, delivery requires referral to a regional or national platform. The availability and accessibility of radiotherapy at a higher center do not necessitate the delivery of surgical care at the same center, although there may be advantages in doing so.

Centralized versus Decentralized Delivery Models

Delivery platforms for surgical cancer services must necessarily be organized into an overall delivery model within a country. It is useful to consider the benefits and risks of different models of surgical cancer service delivery; balancing quality and efficiency with access and coverage demands is a key challenge in delivering surgical cancer care in LMICs. Centralized, specialist surgical platforms for cancer services generally promote quality and efficiency, whereas strengthening delivery platforms peripherally tends to enhance access and coverage (table 13.4).

Table 13.4 Benefits and Risks of Centralized versus Decentralized Surgical Cancer Platforms

Centralized surgical platforms for cancer	Decentralized surgical platforms for cancer
Benefits	***Benefits***
• Standardization of care, higher operative volumes, and specialist surgical care for quality assurance • Economies of scale • "One-stop shop" for cancer services • Multidisciplinary practice for better outcomes • Research and training activities that drive practice forward	• Improved coverage and access for greater equity • Reduced direct nonmedical and indirect costs to patients and families, because of reduced travel time and productivity loss • Reduced referral delays between presentation and definitive care • Surgical platform more cost-effective at the first or second level (Debas and others 2006)
Risks	***Risks***
• Reduced access and increased inequity for rural versus urban populations • May encourage super-specialization and workforce maldistribution	• Inefficient clinical services and duplication • Poor coordination and access to higher-level centers and other cancer disciplines, causing delayed or missed adjuvant care • Poorer quality care

Referral Networks, Service Coordination, and Partnerships

The delivery of surgical cancer care requires functional clinical platforms, as well as strong referral networks and coordination between other cancer services and providers.

Strategies to improve the coordination and links among all platforms providing cancer services can promote high-quality, standardized, and efficient surgical cancer care. For example, India has developed a National Cancer Grid (Pramesh, Badwe, and Sinha 2014), funded by the Government of India, which links facilities providing cancer care, with the goal of standardizing the quality of care, developing uniform guidelines, reducing the variations in care, and facilitating exchanges of expertise and experience between larger and smaller centers. Such links also strengthen referral capabilities

and provider coordination. This is particularly important when diagnostic, surgical, and adjuvant services are spread across different facilities.

Comprehensive cancer centers with multidisciplinary cancer teams have been shown to be the most effective strategy for ensuring high-quality, efficient, and appropriate cancer care in HICs (chapter 11 in this volume; Yip and others 2011). The severe shortage of specialist health workers makes it almost impossible to achieve comprehensive, multidisciplinary centers currently in LICs and difficult to achieve in a manner that ensures high coverage and equity in many MICs. However, even in the absence of a highly specialized cancer workforce, some LMICs are beginning to develop regional or national cancer centers, drawing on expertise within general second- or third-level hospitals. Often, one or two surgeons within a country become well known for providing cancer care and serve as references for the rest of the country, with high numbers of patients referred to them. These reference surgeons and the large urban hospitals in which they typically work can serve as a major focus to drive forward cancer care within countries, provided they are well supported. Although not all surgical cancer services need to be provided at this level, the presence of such centers may strengthen the surgical care provided at other locations through the exchange of knowledge and experience and the strengthening of referral networks.

International partnerships between LMICs or between LMICs and HICs also support the development and delivery of cancer care, including surgical cancer care in low-resource environments. The most effective international partnerships are those that seek to develop local cancer care capacity and that are closely aligned with local needs. The practice of short-term surgical trips that focus on operative resection only, use entirely foreign surgical teams to deliver care, and do not participate in teaching or local capacity-building efforts is not generally an effective model for cancer care.

STRENGTHENING SURGICAL SYSTEMS AND BUILDING CAPACITY

Conducting Baseline Assessment of Capacity

At the country level, policy makers will consider several key elements, especially when considering the most appropriate delivery platforms:

- Burden of cancer
- Stage at diagnosis
- Availability and distribution of surgical and cancer-specific resources in relation to the population and the available resources, current and projected, for the scale-up of cancer care and surgical services

A situational analysis of current surgical and cancer capacity within a country should precede policy, planning, and scale-up efforts (box 13.1).

Developing the Surgical Workforce

Human resources are a crucial component of surgical cancer services, and the development of an effective workforce requires proactive strategic planning at the national level. LICs and many MICS require urgent investment in strengthening the surgical, anesthetic, and supporting cancer workforce—including pathologists, radiotherapists, and nurses trained in perioperative and wound care. The surgical and anesthetic workforce takes time to develop—a minimum of 10 years from entry into medical school to qualification as an accredited surgeon or anesthetist—and workforce planning must take into account projected as well as current needs. Many LICs lack postgraduate surgical training programs and must pay to send their doctors outside the country (and sometimes outside the region or continent) for further training after medical school. This requirement is costly and increases the likelihood that the home countries will not be able to retain the doctors upon training completion. Creating the capacity for accredited postgraduate surgical training in LICs has been shown to be effective and sustainable, allowing countries to achieve national health goals (Anderson and others 2014).

Task-shifting of general surgical procedures—for example, laparotomy, cesarean section, and fracture repair—to nonphysician providers is increasingly used to overcome critical surgical workforce shortages in many LMICs. In Malawi, 93 percent of the surgical workforce is composed of nonphysicians (Henry and others 2014). However, this process poses risks for developing surgical cancer services. It is generally agreed that task-shifting to nonphysicians for cancer surgery is not possible owing to case complexity and quality concerns. The failure to address the shortage of surgeons in LMICs and the overreliance on nonphysician surgical providers to deliver surgical services will significantly hamper the ability of countries to respond to the substantial projected increase in cancer requiring surgical treatment in the future. Attempts to address the surgical workforce crisis need to focus on increasing the number of surgeons through recruitment and retention to ensure long-term success in meeting surgical needs. Training of surgical nursing staff is also critical to ensure optimal postoperative care and surgical outcomes.

In settings with an adequate surgical workforce, as in some MICs, expanding the skills of the existing workforce to provide quality surgical cancer services through ongoing training will improve outcomes and maximize health gains.

Improving Infrastructure and Procurement Processes

The significant deficits in basic infrastructure, equipment, supplies, and procurement processes in many LMICs need to be addressed early in any scale-up plans. These deficits include an absence of reliable power, water, and oxygen, as well as insufficient or dilapidated operating theaters and surgical and sterility equipment and supplies. Attention to the development of sustainable supply chains and procurement practices is important. Improving and developing the surgical infrastructure within countries often requires capital outlays; in LICs, these costs may need to be met through development assistance.

Further research is needed as to the most appropriate and cost-effective infrastructure and equipment for surgical cancer care specific to the resource level. In some cases, the use of technology in LMICs, for example, human papillomavirus DNA testing, can lead to leapfrogging of cancer delivery models over HICs and assist in detecting cases at stages amenable to curative surgical treatment. However, the greatest overall gains are likely to come from the planned development of more basic surgical infrastructure, with good population coverage, rather than the ad hoc purchasing or donation of state-of-the art technology or facilities that can be accessed by only a small percentage of the population. Maintenance and repair of surgical infrastructure and equipment are major challenges; an estimated 40 percent of the equipment in LMICs is out of service, compared with less than 1 percent in HICs (Howitt and others 2012). The inappropriate deployment of medical technologies from HICs to LMICs is a significant contributor to this problem.

Promoting Quality and Ensuring Safety

Prerequisite to the scale-up of surgical cancer services is consideration of how to promote and ensure quality and safety. These are fundamental components for achieving good outcomes and building community trust in cancer and surgical care. All countries can embrace the goal of high-quality and safe surgical care, regardless of development status. Specific strategies for LMICs are listed in box 13.2.

Box 13.2

Strategies to Improve the Quality of Surgical Cancer Services in LMICs

All LMICs

- Clinical management guidelines and surgical standards developed specifically for low-resource settings
- Collection of outcome data
  - Case fatality rates
  - Risk-adjusted postoperative mortality rates
- Morbidity and mortality meetings and clinical audits
  - Encouraged reflection on practice and identification of areas for improvement
- Multidisciplinary approach to diagnosis and treatment management
  - Local
  - International, for example, via telemedicine links
- CME for all surgical cancer providers
  - CME and regular courses for updates on surgical technique, patient selection, postoperative care, and systemic therapy

LIC-specific strategies

- Focus on developing strong general surgical services and referral mechanisms
- Operation within the limits of the human and infrastructural resources to reduce poor outcomes
- Establishment of formal links among centers providing surgical and cancer care within a country, especially between different referral levels
- Development of international twinning arrangements

box continues next page

Box 13.2 (continued)

- Support for training, diagnosis, and case management decisions in centers providing cancer care
  - South-South
  - North-South
  - Local and international NGOs

MIC-specific strategies

- Development of regional and national comprehensive cancer centers
  - Provision of locally appropriate management guidelines for own country
  - Provision of training support and outreach clinical services for peripheral facilities
- Establishment of cancer grids or partnerships
  - Encourage collaboration and standardization of surgical care
- Development of regional and national cancer registries to track outcomes
- Requirements for mandatory reporting of case volumes, procedures, and outcomes in all sectors providing surgical cancer services (government, private for-profit, and private not-for-profit)

Note: CME = continuing medical education; LICs = low-income countries; LMICs = low- and middle-income countries; MICs = middle-income countries; NGOs = nongovernmental organizations.

Scaling Up Surgical Services for Cancer

The requirements for the scale-up of surgical services to meet cancer needs are country specific, dependent on current and projected patterns of disease, available health resources and health systems capacity, amounts of domestic spending on health, and distribution of the population. Some general recommendations can be made, however, to guide policy makers based on the resource patterns, income level, and development status.

LICs should initially focus on building general surgical capacity and inpatient care within their health systems, including investing in human resources and hospital infrastructure and developing effective supply chains and referral networks. Without these fundamentals in place, it is not appropriate to embark on cancer surgery–specific treatment planning. Adequate general surgical capacity will allow countries to deliver the surgical components of the minimum cancer intervention package, such as diagnosis and treatment of breast cancer and treatment of precancerous cervical lesions, at the basic resource level. Importantly, it will also serve as a base for the effective scale-up of a range of cancer-specific services.

In MICs with basic or limited surgical resources in place, the focus should be on developing coordinated and context-specific cancer systems and services that improve the quality and standards and ensure equitable access to surgical cancer care through sound public policy and health governance. Many MICs have national health programs, services, and structures geared to the delivery of vertical programs, rather than horizontal health system–based approaches (Anderson and others 2014). Surgical care may be present, but coordination and delivery within a functioning health system may be weak. As countries move beyond the most basic package of cancer care delivered within a single clinical encounter, they will require complex and highly coordinated delivery systems, with surgical care embedded within. Improving governance and regulation around surgical service provision will assist MICs to improve quality, reduce waste and inefficiency, and promote equity. Large imbalances between private and public sector provision of surgical cancer services are seen in some MICs, such as India. Unregulated, these imbalances can drain resources (for example, higher salaries in the private sector drain surgeons away from the public sector), hinder quality and transparency (for example, through inappropriate, nonstandardized, or unwanted surgical treatment), increase medical impoverishment (for example, treating patients until finances have run out and then transferring them to the public sector), and create a two-tiered system of cancer care (Flores and others 2008; Pramesh and others 2014).

Complementing steps to improve surgical capacity is the need to simultaneously focus on removing patient barriers to the uptake of surgical cancer services to improve cancer outcomes and promote equity. Delayed presentation increases the morbidity, mortality, and micro- and macroeconomic costs associated with cancer. As countries move to introduce financial risk protection and progressive universal health coverage for their populations, there is a need to ensure coverage for a basic package of inpatient care, including surgical care, early in the expansion pathway (Jamison and others 2013).

Cancer care requires strong, coordinated health systems and services, rather than an isolated focus on

surgical services. Early detection and comprehensive treatment improve cancer outcomes. Improving the rate of surgical cure in LMICs requires coordinated efforts across the health system to achieve stage-shifting, combined with efforts to improve surgical capacity to deliver effective treatment. For example, clinical breast examination provided at a community-level platform by trained allied health workers has led to stage-shifting of breast cancer in India, making it more amenable to surgical cure (Sankaranarayanan and others 2011).

ECONOMIC CONSIDERATIONS OF SURGICAL CANCER CARE IN LMICs

There have been few economic evaluations of cancer care in LMICs; among these, surgical interventions and surgical services have received almost no attention. Tables 16.3 to 16.8 in chapter 16 summarize the available cost-effectiveness evidence for the detection and treatment of the priority cancers considered in this volume. Notably, surgical interventions that are feasible at the basic, limited, and enhanced resource levels have barely been assessed, even in upper-middle-income countries. Chemotherapy, in comparison, is a far more studied treatment modality, given concerns about its high cost and poor accessibility, regardless of resource level. For example, in a systematic review of the Tufts Medical Center Cost-Effectiveness Analysis Registry of cancer-related studies set mainly in HICs, 53.3 percent of the studies were concerned with pharmaceutical interventions, compared with 13.3 percent with surgical interventions (Greenberg and others 2010).

Yet, surgery is the most significant life-saving intervention in cancer treatment. Coupled with their wider roles in the cancer care spectrum, as a diagnostic modality and in palliative care, surgery and surgical services have the potential to be good-value choices for health care investment in LMICs. The expansion of surgical interventions for solid tumors routinely found at early stages is recommended in this volume based on feasibility, at even basic and limited resource levels, and suggested cost-effectiveness evidence from higher resource levels (chapter 16 in this volume).

Economic Studies

In the enhanced resource settings of MICs, limited cost-effectiveness analyses of comparisons between simple and enhanced surgical techniques or between surgery and other treatment modalities are emerging (He and others 2011; Lu and others 2012; Tan and others 2013). The results are set in single hospitals and are very specific to the local cost structure and, especially given the heterogeneity of health care financing in MICs, are not generalizable to other countries. The results often reflect the increasing ability and desire of individuals and governments to pay for a perceived (if unsupported) qualitative improvement in outcomes, balanced against increased costs of more expensive (often imported) equipment, more highly trained personnel, and more supporting services. However, these studies also often provide insights into and implications for the structuring of health care financing and equitable access.

In reviews of the literature, basic surgical services in a variety of low-resource settings were reported to be cost-effective or very cost-effective, according to the World Health Organization threshold definitions (Chao and others 2014; Grimes and others 2014). Local costing studies and partial economic evaluations (for example, where costs or effectiveness components are assessed but not directly linked) or evaluations from narrower perspectives (for example, from provider or patient perspectives rather than societal perspectives) can provide insights for inputs into fuller cost-effectiveness studies or for intervention adaptation in implementation. Detailed costing of surgery procedures, excluding preoperative and postoperative care, in a selection of hospitals of varying resources and settings in India showed that the salaries and benefits of operating theater staff formed 42 percent of the cost of a hysterectomy in a first-level hospital, compared with 48 percent in a third-level hospital (Chatterjee and Laxminarayan 2013). Overhead costs were higher at the first-level hospital, however, constituting 30 percent versus 20 percent of hysterectomy costs at the third-level hospital. This finding suggests that if the outcomes are similar, it may be equally or more cost-effective to perform simple hysterectomies at a first-level hospital, thereby improving access for a wider population in India.

In costing breast cancer care in central Vietnam, a lower-middle-income country, Lan and others (2013) found the surgical treatment, while a large cost component, was significantly less expensive than chemotherapy. Over a five-year course of care for breast cancer that included diagnosis, initial treatment, and follow-up care, surgery accounted for 8.4 percent of the total cost (Lan and others 2013).

Financing

In many LMICs, out-of-pocket payment for surgical cancer services may be the main form of financing (Ilbawi, Einterz, and Nkusu 2013). Lan and others (2013) found that the absence of health insurance or financial risk protection from the costs of cancer care in Vietnam was the main barrier to the uptake of breast cancer

treatment services. The impoverishment impact of surgical conditions on a household is immense, especially in the context of cancer. In a study in rural Bangladesh, the impoverishment rates from cancer hospitalization and surgical procedures were four- to sevenfold higher than the impoverishment average of 3.4 percent for all health services (Hamid, Ahsan, and Begum 2014). High user fees and out-of-pocket payments also increase the likelihood that patients will not return at all for definitive surgical care. In a study of patients presenting at a first-level hospital in rural Cameroon, preoperative payment greater than US$310 and a recommended procedure for cancer significantly increased the likelihood of patients not returning for surgical care as advised following an initial assessment (Ilbawi, Einterz, and Nkusu 2013).

Gaps in the Economic Evidence

The dearth of economic evaluations for surgical cancer services means that many knowledge gaps exist in making investment decisions. This section identifies some of the fundamental areas that can be addressed to start an economic evidence base of cancer surgery interventions and surgical services.

Burden

Country-level estimates of the health burden of resectable cancer, refined by site, incidence, and stage, are unknown but required for the underlying foundation of an economic evidence base. Estimates of avertable burden help direct the considerable resources needed for economic evaluations to appropriate areas of research, identify proper comparators, and give a measure against which to weigh costs. In the United States, 61.4 percent of patients admitted to hospital with a cancer diagnosis required a surgical procedure (Rose and others 2014). Similar country-level estimates for operative cancer need in LMICs are not available. Given the increasing and changing burden of cancer (see chapter 2 in this volume) relative to communicable diseases and among sites and nations, the extent of the potential value of surgical treatments needs to be quantified.

Costing

There is a general lack of costing studies on which to build cost-effectiveness studies of surgical cancer services. As a first step, those that exist for general surgical services, such as the hospital-based studies of Chatterjee and Laxminarayan (2013), could be validated for surgical cancer services. This process requires the characterization and differentiation of cancer surgery costs versus general surgery costs, including the appropriate apportioning of overhead costs to cancer surgery and the differential training of personnel. In LMICs in particular, there is need for costing of the surgical cancer systems, processes, and platforms that would allow the identification of minimized patient travel time and related productivity costs.

Effectiveness

The short- and long-term effectiveness of surgical services in cancer cure and control, measured at the national and sub-national level, could be estimated to better inform cost-effectiveness analyses. The efficacy of cancer surgery may be severely compromised by poor access to supporting cancer services, including chemotherapy and radiotherapy, or by poor quality surgical care. However, there has been little evaluation of the potential impact of this on cancer outcomes in LMICs.

CONCLUSIONS

Surgical services are a central component of cancer cure and control in all resource settings, playing a key role in the diagnosis, treatment, and palliation of most solid tumors. Basic surgical cancer care can be affordable and effective, even in countries with substantial resource constraints. This fact has not been well recognized in previous dialogues on cancer control in LMICs.

Major resourcing, geographic, financial, and sociocultural barriers to access to surgical cancer services exist in many LMICs. Given the high case-fatality rates from common malignancies such as breast cancer in LMICs, as well as the large projected increase in cancer incidence in these regions over the next 20 years, countries would benefit from strategic and proactive approaches to the planning and delivery of surgical cancer services. Unfortunately, very little is known about the most effective or cost-effective delivery platforms for surgical cancer care in LMICs to guide policy makers, or about how applicable or transferable models and lessons from HICs are to low-resource settings. Current models of care delivery in LMICs have been largely developed through experience, pragmatism, and consensus, rather than through rigorous academic or economic evaluation.

Key considerations in the scale-up of surgical cancer care in LMICs that are supported by evidence include the urgent need to develop the surgical workforce, improve basic general and surgical infrastructure, and strengthen supporting services. Coordinated integration of surgical services with other cancer services and the development of cancer networks and partnerships are also required to promote quality and standards.

Most important, efforts to improve surgical capacity in LMICs need to be coupled with strategies to promote cancer stage-shifting. Resource-appropriate efforts

across the health system to facilitate the early detection of surgically treatable cancers and reduce barriers to timely service uptake are required to realize fully the curative benefits—as well as the associated social and economic gains—that surgery can offer.

NOTES

World Bank income classifications as of July 2014 are as follows, based on estimates of gross national income per capita for 2013:

- Low-income countries: US$1,045 or less
- Middle-income countries:
  a) Lower-middle-income: US$1,046–US$4,125
  b) Upper-middle-income: US$4,126–US$12,745
- High-income countries: US$12,746 or more

1. Typically, a country's income level and development status track with its health resource level. However, this is not always the case; there may be significant variation within countries in resource availability, according to geography and income quintile.

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