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Essential equipment and services for otolaryngology care: a proposal by the Global Otolaryngology-Head and Neck Surgery Initiative

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Purpose of review

To highlight the need for comprehensive resource lists to provide baseline care of otolaryngologic conditions; to present a proposed list of essential equipment and services that may be applied toward surgical systems research, policymaking, and charitable efforts in global otolaryngology-head and neck surgery.

Recent findings

To provide effective and high-quality surgical care across care settings, there must be a global standard for equipment and ancillary services necessary to provide baseline care. Though there have been efforts to devise resource standards via equipment lists and appraisal tools, these have been limited in scope to general surgery, emergency care, and a few other subspecialty surgical contexts. Recent efforts have brought attention to the significant burden imposed by otolaryngologic conditions such as hearing loss, otitis media, head and neck cancer, head and neck trauma, and upper airway foreign bodies. Yet, there has not been a comprehensive list of resources necessary to provide baseline care for common otolaryngologic conditions.

Summary

Through an internal survey of its members, the Global Otolaryngology-Head and Neck Surgery Initiative has compiled a list of essential equipment and services to provide baseline care of otolaryngologic conditions. Our efforts aimed to address common otolaryngologic conditions that have been previously identified as high-priority with respect to prevalence and burden of disease. This expert-driven list of essential resources functions as an initial framework to be adapted for internal quality assessment, implementation research, health policy development, and economic priority-setting.

Keywords

equipment, global surgery, otolaryngology, policy

INTRODUCTION

Safe surgical and procedural care is a critical component of ensuring high-quality healthcare delivery in global settings [1]. Effective surgical care requires costly infrastructure for the acquisition, sterilization, and maintenance of essential equipment and robust support services such as imaging, laboratory testing, histopathology, and blood banking. The field of otolaryngology-head and neck surgery (OHNS) encompasses a breadth of conditions and operative techniques necessitating a wide variety of equipment to provide essential care. Given variations in resource access and health system infrastructures, availability of equipment varies regionally and by practice setting.

Surgical subspecialties, such as pediatric surgery, have created essential equipment and health service frameworks to promote the quality of surgical infrastructure, advocate for resources, and enable surgeons to deliver standard surgical care in diverse

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KEY POINTS

- Equipment and ancillary services remain a significant barrier to effective, high-quality surgical care in health systems throughout the world.
- Essential resource checklists serve to prioritize infrastructural investment and guide targets for capacity assessment across global settings.
- This list of essential equipment and ancillary services may serve as a framework for quality assessment, implementation research, policy development, and economic priority-setting in otolaryngology–head and neck surgery.
- Stratification of equipment and services by relative priority at various institutional levels helps to make recommendations appropriate to specific contexts of otolaryngologic care.

settings. To date, no inventory of essential equipment and services has been developed for OHNS on a global scale. Our review aims to highlight guidelines for prioritization of resources and to provide a list of essential equipment for OHNS surgical care, based on international input from experienced OHNS providers.

PRIORITIZING EQUIPMENT AND ANCILLARY SERVICES IN SURGERY

Surgical, anesthetic, and ancillary medical services are essential for the treatment of operable conditions, which are estimated to comprise 28–32% of the total global burden of disability and mortality [2,3]. Surgery has been under-prioritized within global health efforts for reasons including the perceived high cost of surgical infrastructure and complexity of surgical care delivery [4]. Although the moral imperative to provide high-quality health-care is reason enough to expand access to surgical care, surgery has also been proven to be a cost-effective intervention. For example, a 2014 systematic review of cost-effectiveness studies in low- and middle-income countries (LMICs) determined that surgical intervention can be cost-effective or very cost-effective based on World Health Organization (WHO) criteria and compares favorably to currently accepted public health interventions [5]. Without considering the prioritization of surgical equipment in certain subspecialties, such as OHNS, surgical care cannot be given in a satisfactory manner.

A core component of the delivery of surgical care is specialized equipment and infrastructure. In 2005, the WHO launched its Global Initiative for

Emergency and Essential Surgical Care which published standards for public district hospitals to promote adequately equipped operating theaters, basic intensive care units, and the ability to treat several life-threatening and highly-disabling surgical conditions [6,7]. To this end, the WHO drew on government, clinical, biomedical engineering, and medical device stakeholders to increase the availability of essential surgical equipment in LMICs [7–9]. Several inventories have since been developed to appraise surgical capacity, including the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care (SAT) [10]; the Personnel, Infrastructure, Procedures, Equipment, and Supplies (PIPES) tool [11]; and the International Assessment of Capacity for Trauma (INTACT) index [12]. These inventories have demonstrated stark surgical equipment shortages in various countries in sub-Saharan Africa [13–17], Asia [18–21], and Central/South America [22–24], highlighting the need for government involvement in surgical capacity building for both infrastructure and personnel.

The next generation of surgical equipment appraisal has been marked by the delineation of surgical equipment lists beyond the context of general and trauma surgery. The WHO and the World Federation of Societies of Anesthesiologists produced the International Standards for a Safe Practice of Anesthesia, which introduced concrete recommendations for anesthetic equipment and support personnel at various care levels [25]. The Global Initiative for Children’s Surgery, an independent consortium of pediatric surgical providers, created consensus guidelines on optimal supplies and equipment for the care of pediatric surgical conditions in LMICs [26,27]. Surgical subspecialty groups have also adapted the existing PIPES tool to enable the evaluation of neurosurgical and pediatric surgical capacity, thereby broadening the scope of existing assessment tools [28,29]. Such surgical equipment lists are used not only for infrastructure assessment but also for internal quality improvement, surgical policy development by health ministries, and investment priority-setting for advocacy and charitable efforts.

ESSENTIAL EQUIPMENT AND SERVICES FOR OHNS CARE

OHNS conditions remain relatively understudied with respect to global surgical care delivery, despite OHNS conditions representing a significant burden of disease [30]. The Institute for Health Metrics and Evaluation’s Global Burden of Disease study identified that hearing loss (with a ≥ 20 -dB threshold for mild hearing loss) affects 1.57 billion people

globally and is the third largest cause of disability in the global burden of disease [31[■]]. Otitis media, one of the most common and preventable causes of hearing loss in children, has an estimated incidence of 471–709 million cases per year [32]. Head and neck cancers account for 5.7% of global cancer-related mortality, with a significantly higher mortality burden and subsequent economic loss in LMICs compared to high-income countries (HICs) [33[■]]. Other OHNS conditions with high global burden of disease include upper respiratory infections, cleft lip/palate, head and neck trauma, pediatric foreign body, and deep neck space infections [34[■], 35,36[■]].

The cost of acquiring and maintaining subspecialty-specific equipment has been identified as a pronounced barrier to care for OHNS conditions [30,37]. Recent work conducted during the COVID-19 pandemic further highlighted challenges faced by otolaryngologists working in LMICs, who faced obstacles such as insufficient personal protective and surgical equipment to maintain surgical output [38]. Despite the high global burden of OHNS conditions, there is not yet a description of essential surgical equipment necessary for the delivery of high-quality OHNS care worldwide. To fill this gap, the Global OHNS Initiative developed an expert-driven list of essential equipment and services for the delivery of high-quality OHNS surgical care.

THE GLOBAL OTOLARYNGOLOGY–HEAD AND NECK SURGERY INITIATIVE: ESSENTIAL EQUIPMENT AND SERVICES

The Global OHNS Initiative is a global consortium of OHNS clinical providers, trainees, and researchers with a vision for “*universal access to high-quality, safe, timely, and affordable care for those with OHNS conditions*”. To begin defining the role of OHNS care within comprehensive health systems, the group previously used the Delphi methodology to identify a consensus of priority OHNS conditions and procedures which all national health systems should be capable of managing [35]. The initiative then used these findings to develop an expert-driven list of the minimal equipment necessary for the medical and surgical care of the priority conditions. This list was created under the assumption that a facility providing OHNS care would already have the resources required for general surgery care; as such, equipment was excluded if they were included in most general surgery equipment checklists [10–12]. OHNS providers across a variety of practice settings were consulted to add additional equipment or services regularly employed in their clinical practice.

Once a preliminary list was compiled, an internal survey was disseminated to OHNS providers and advanced-level trainees within the initiative. Respondents to the survey included respondents who practice in eleven countries, including the United States, Uganda, Israel, Pakistan, Kenya, Lebanon, Chile, Myanmar (Burma), the United Kingdom, India, and Austria. The equipment included in the survey spanned the following OHNS subspecialties: general otolaryngology, otology, head and neck surgery, rhinology, skull base surgery, and pediatric otolaryngology. Providers were asked to rate the utility of each type of equipment and service at the primary and tertiary care levels, which were defined as follows:

- (1) Primary = ear, nose and throat (ENT) care provided at a community-level hospital or clinic
- (2) Tertiary = a referral-based center for specialist or sub-specialist ENT care not regularly managed at the community level

Equipment and ancillary service utility was categorized under three designations:

- (1) “Essential” – This equipment/service must be accessible in-house and is critical to the care of the ENT conditions encountered at the respective care level.
- (2) “Aspirational” – This equipment may not be necessary to provide care at this respective healthcare level but could be useful for ENT needs. If it were available, it would be regularly used.
- (3) “Nonessential” – This equipment/service is not necessary to manage the ENT conditions managed at the respective care level. There may be sufficient substitutes that perform the same function as this equipment or service.

The internal survey results were compiled and reviewed through multiple group consensus meetings. A final list of essential equipment and ancillary services for baseline OHNS care was generated (Tables 1 and 2). This list of essential OHNS equipment and services may serve as a resource to support the development of high-quality OHNS care in various healthcare settings and to permit a high standard of care for all patients with OHNS conditions.

Stratification of equipment and services by primary and tertiary facility levels permits a more nuanced understanding of the resources needed for appropriate OHNS care. We also categorized equipment as “essential” or “aspirational” to

Table 1. A list of essential equipment for baseline care in otolaryngology-head and neck surgery as compiled by the Global OHNS Initiative

| General care | | |
|-----------------------|--|---|
| | Primary | Tertiary |
| Essential | Headlights 512 Hz turning fork Laryngeal mirror Otoscope and ear speculum Suction aspirator Ear forceps Ear curettes Nasal speculum Flexible endoscopy Bipolar/diathermy Bone-cutting drill Operating microscope (suitable for OHNS procedures) | Headlights 512 Hz turning fork Laryngeal mirror Otoscope and ear speculum Suction aspirator Ear forceps Ear curettes Nasal speculum Flexible endoscopy Bipolar/diathermy Bone-cutting drill Operating microscope (suitable for OHNS procedures) Loupes Bedside/POC ultrasound Facial nerve monitoring |
| Aspirational | Loupes Bedside/POC ultrasound Facial nerve monitoring | |
| Non-essential | | |
| Endoscopy | | |
| | Primary | Tertiary |
| Essential | Endoscopy tower (light source and video processor) Hopkin's rod (rigid telescope) Rigid bronchoscope Rigid bronchoscope accessory instruments Direct laryngoscopy and biopsy set Esophagoscope | Endoscopy tower (light source and video processor) Hopkin's rod (rigid telescope) Rigid bronchoscope Rigid bronchoscope accessory instruments Direct laryngoscopy and biopsy set Esophagoscope Flexible bronchoscope |
| Aspirational | Flexible bronchoscope | |
| Non-essential | | |
| Otology | | |
| | Primary | Tertiary |
| Essential | Otologic drill Hammer and gauge Otology set (or equivalent supplies) Myringotome (surgical knife for paracentesis of eardrum) Tympanostomy set (or equivalent supplies) Cutting diamond-head drill burrs Alligator ear forceps | Otologic drill Hammer and gauge Otology set (or equivalent supplies) Myringotome (surgical knife for paracentesis of eardrum) Tympanostomy set (or equivalent supplies) Cutting diamond-head drill burrs Alligator ear forceps Otoendoscope Bone pate Cochlear implant Jeweler forceps |
| Aspirational | Otoendoscope Bone pate | |
| Non-essential | Cochlear implant Jeweler forceps | |
| Head and neck surgery | | |
| | Primary | Tertiary |
| Essential | Neck dissection set (or equivalent supplies) Tracheotomy tubes of different sizes | Neck dissection set (or equivalent supplies) Tracheotomy tubes of different sizes Endovascular microscope and loupes Maxillofacial plating set Microsurgical/microdissection set (or equivalent supplies) Tracheoesophageal voice prosthesis |
| Aspirational | Endovascular microscope and loupes Maxillofacial plating set | |
| Non-Essential | Microsurgical/microdissection set (or equivalent supplies) Tracheoesophageal voice prosthesis | |

Table 1. (Continued)

| Rhinology and sinus surgery | | |
|-----------------------------|--|--|
| | Primary | Tertiary |
| Essential | Straight (0-degree) nasal endoscope Angled (30-degree) nasal endoscope Sinus surgery set (or equivalent supplies) Rhinology, rhinoplasty, septoplasty set (or equivalent supplies) | Straight (0-degree) nasal endoscope Angled (30-degree) nasal endoscope Angled (45-degree) nasal endoscope Angled (70-degree) nasal endoscope Sinus surgery set (or equivalent supplies) Rhinology, rhinoplasty, septoplasty set (or equivalent supplies) Rotation (suction) microdebrider Endoscopic dissection tools (miniature forceps, dissectors, etc.) Anterior skull base dissection set |
| Aspirational | Angled (45-degree) nasal endoscope Angled (70-degree) nasal endoscope Rotation (suction) microdebrider Endoscopic dissection tools (miniature forceps, dissectors, etc.) | Computer-assisted navigation for skull base surgery |
| Non-essential | Anterior Skull Base Dissection Set Computer Assisted Navigation for Skull Base Surgery | |
| Pediatric otolaryngology | | |
| | Primary | Tertiary |
| Essential | Mouth gag Suction electrocautery Tonsillectomy set (or equivalent supplies) Adenoidectomy set with adenotomes Pediatric airway set (with airway dilators, balloons, choanal atresia perforators) | Mouth gag Suction electrocautery Tonsillectomy set (or equivalent supplies) Adenoidectomy set with adenotomes Pediatric airway set (with airway dilators, balloons, choanal atresia perforators) Coblation (cold ablation) |
| Aspirational | Coblation (Cold Ablation) | |
| Non-Essential | | |

Equipment groupings occur by subspecialty of use. Equipment are categorized separately at the primary and tertiary care levels, denoted by each column. Equipment categorizations include essential, aspirational, or nonessential with respect to each care level.

Table 2. A list of essential services for baseline care in otolaryngology-head and neck surgery as compiled by the Global OHNS Initiative

| | Primary | Tertiary |
|----------------------|---|--|
| Essential | Audiology Histopathology and cytology Microbiology Blood serology Blood bank Equipment sterilization Biomedical equipment maintenance X-ray radiography Computerized tomography (CT) Ultrasonography (with specialist ultrasonographer and radiologist interpretation) | Audiology Histopathology and cytology Microbiology Blood serology Blood bank Equipment sterilization Biomedical equipment maintenance X-ray radiography Computerized tomography (CT) Ultrasonography (with specialist ultrasonographer and radiologist interpretation) Magnetic resonance imaging (MRI) Positron emission tomography (PET) Speech-language pathology Medical oncology consult Radiation oncology consult |
| Aspirational | Magnetic resonance imaging (MRI) Positron emission tomography (PET) Speech-language pathology Medical oncology consult Radiation oncology consult | |
| Non-essential | | |

Services are categorized separately at the primary and tertiary care levels, denoted by each column. Service categorizations include essential, aspirational, or nonessential with respect to each care level.

indicate relative prioritization. Aspirational equipment often included items that are not absolutely necessary for the provision of OHNS care, but have grown increasingly popular within high-resource settings to improve patient safety and overall quality of care. For the “essential” categorization, survey respondents prioritized global standards of care over newer technologies to create a more equitable benchmark that could be reached by a greater proportion of OHNS providers, facilities, or hospital systems.

These categorizations are subject to change with the evolution of disease burden, training standards, and equipment availability.

Survey responses highlighted variations in equipment use as a result of resource constraints and training standards. At the primary level, in the general otolaryngology care section, laryngeal mirrors for indirect laryngoscopy were deemed essential (Table 1). However, clinicians in HICs have trended away from using laryngeal mirrors, instead utilizing fiberoptic laryngoscopy (FOL) or rigid laryngeal endoscopy for visualization of the supraglottic and glottic regions due to patient comfort and completeness of laryngeal examination [39,40]. Thus, both FOL and laryngeal mirrors were considered essential to encompass the spectrum of infrastructure availability and evolving training standards across economic strata.

For endoscopy at the primary level, respondents categorized a rigid bronchoscope as essential and a flexible bronchoscope as aspirational (Table 1). In subsequent discussion, respondents indicated that almost any tracheal foreign body, lesion, or tumor can be treated using a rigid bronchoscope. However, current literature demonstrates that flexible bronchoscopy may help to definitively exclude foreign body aspiration when rigid bronchoscopic examination is equivocal or unable to reach more distal locations in the airway [41,42]. Although typically a tool in the arsenal of pulmonologists and thoracic surgeons, the use of this equipment by OHNS providers continues to expand [43,44], indicating the potential for recategorization of equipment as essential in future iterations of these lists.

In open-ended responses, a few survey respondents reported various applications of equipment to provide care beyond the original intended use. For example, two respondents commented that nasal endoscopes were frequently repurposed for otologic procedures and pediatric airway foreign body removal. Another respondent remarked that their facility used otologic instruments for pediatric anterior skull base surgery. Born out of equipment shortages during the COVID-19 pandemic, there has been an interest in developing cost-effective strategies for

surgical capacity – including the reuse and repurposing of equipment [45,46]. A recent study on the benefits of equipment repurposing reported that endoscopic approaches to the middle ear show improved anatomic visualization with similar audiometric and surgical outcomes seen with binocular approaches [47]. What is more, the endoscopic surgical setup has far fewer logistical and cost-related barriers compared to the otologic microscopic surgical setup, making the endoscope a feasible option for otologic surgical teaching in LMICs [47]. Thus, the range of applications for certain equipment items was taken into consideration when categorizing equipment priority for the lists.

Loupes were categorized by survey respondents as aspirational at the primary level compared to an operating microscope for microsurgical work in head and neck operations, which was deemed essential at the primary level (Table 1). Loupes-only magnification has been utilized for microsurgical anastomosis in a variety of applications [48,49]; however, the categorization of “aspirational” may reflect the fact that loupes must be fitted to an individual surgeon as opposed to microscopes being accessible to any operating surgeon who is able to adjust magnification.

Operating microscopes may also be shared with other surgical services that require an operating microscope. Otoendoscopes were also deemed aspirational at the primary level (Table 1), despite evidence demonstrating ergonomic benefits [50] and similar outcomes compared to traditional microscopic ear surgery [51,52]. This is perhaps due to its relatively recent arrival to the otology armamentarium and its steep learning curve for those trained only with operative microscopes to reliably benefit from the use of otology equipment [53]. It should be noted that at the tertiary level, only computer-assisted navigation for skull base surgery was deemed aspirational (Table 1). This system, which provides real-time computed tomography-based guidance in surgery, may have been considered aspirational due to its prohibitive cost, lack of definitive evidence supporting improved outcomes, and the need for trained personnel for its use [54].

This survey included perspectives of OHNS providers from both HICs and LMICs to describe the need for OHNS equipment and services across economic strata. There are broad uses for this set of essential equipment and services. First, this list might be deployed to measure resource availability, expanding the potential for current surgical capacity assessments to include OHNS care. Accurate capacity assessments are critical

for internal appraisals of health systems and broader goals in academic global surgery. Second, this list can be used to guide investment in OHNS equipment by ministries of health, health systems, and facilities. OHNS conditions have been under-emphasized in national surgical plans; however, the list of essential equipment and services may inform policy development to improve OHNS care. Third, this list may be used to advocate for the charitable provision of essential equipment in countries that lack access to equipment needed for high-quality OHNS care. Similar lists have been used to leverage HIC academic centers, medical equipment companies, and nongovernmental entities to donate “essential equipment kits” to resource-limited clinical centers [38]. Together, these lists can be used to optimize resource allocation and support a higher standard of OHNS care for patients around the world

CONCLUSION

The lack of equipment and ancillary support services continues to be a significant barrier to OHNS care in health systems around the world. Surgical providers have developed essential resource checklists to fulfill the need for infrastructure capacity assessment and targeted resource investment. This expert-driven list of essential OHNS equipment and services functions as an initial framework to be adapted for internal quality assessment, implementation research, health policy development, and economic priority-setting. Ultimately, we hope that these lists of essential equipment and services for care delivery will contribute to improved health outcomes globally and shape benchmarks of quality for OHNS care delivery.

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Conflicts of interest

There are no conflicts of interest.

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This study from the Global OHNS Initiative utilized the Delphi method among a cohort of otolaryngologists across several countries to derive a consensus on the priority otolaryngology-head and neck surgery conditions and surgical procedures that all national health systems should be capable of managing. This list was used to compile the initial list of equipment and services for baseline management of high-priority OHNS conditions.

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