


ORIGINAL RESEARCH

Otolaryngology burden of disease and surgical case triage in resource-limited settings: An example from Cameroon

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Abstract

Objectives: Otolaryngology services worldwide faced an unprecedented demand for case triage during the SARS-CoV-2 pandemic. We propose and apply a novel case-leveling schema in a resource-limited setting. Describing the surgical burden of otolaryngologic disease in this setting may critically inform resource planning to address global surgical disparities.

Methods: This is a retrospective study of otolaryngology cases performed over a 28-month period (1/2016-4/2018) at a hospital in rural Cameroon. Case details were collated and categorized as a surrogate measure of otolaryngologic disease in resource-limited settings. A case-leveling schema based on temporal urgency and anticipated impact on health was proposed and applied.

Results: 1277 cases took place during the study. The largest proportion of cases were head and neck (517, 40%), followed by pediatrics (316, 25%). A four-tiered leveling system was generated: level 1 cases were immediately life-saving; level 2 cases were expected to result in a significant return to functions of daily living, or would prevent future death from cancer; level 3 cases aimed to significantly improve quality of life; level 4 cases were purely elective. Upon application of the schema, most cases were deemed to be level 2 (661, 52%).

Conclusion: We use our experience in a resource-limited setting to generate and apply a novel schema to be used for otolaryngology case triage in services facing unprecedented states of emergency such as the SARS-CoV-2 pandemic. This is the first study describing the surgical otolaryngologic disease burden in a resource-limited setting, data which may be used for future resource allocation.

Level of Evidence: 4.

KEYWORDS

clinical practice guidelines, healthy policy, training program

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1 | INTRODUCTION

In 2015, the Lancet Global Commission on Surgery identified the great need for access to timely surgical services in low and middle income countries (LMIC), and urged stakeholders to include global surgery when considering resource allocation. It has been estimated that greater than 99% of Western Sub-Saharan Africa has no access to timely surgical services.¹ This is assumed to be true regarding surgical subspecialty care including otolaryngology, a field noteworthy for its treatment of a wide variety of disease representing all levels of urgency.

Addressing gaps in surgical care requires country and context-specific strategic planning,² though the index Bellwether cases (caesarian delivery, laparotomy, and treatment of open fracture) often cited do not speak to the provision of otolaryngologic care. The spectrum of disease treated by otolaryngologists provides a unique opportunity to introduce a surgical case-levelling system that may be applicable not only in resource-limited settings as a tool for resource allocation, but also in developed health systems facing states of emergency. Case triaging language, formally or informally, has recently become recognized out of necessity during the SARS-CoV-2 pandemic: during this time, hospitals worldwide were required to determine which surgical cases were considered truly urgent, and which to prioritize upon the resumption of non-urgent surgery.³

To examine and characterize the burden of surgical otolaryngologic disease in a resource-limited setting, we present a descriptive study of recent surgical cases performed at a not-for-profit hospital in rural northwestern Cameroon, a country in sub-Saharan Africa. We also propose and apply a case-levelling schema which health systems may find useful when discussing resource allocation for otolaryngologic surgery.

2 | METHODS

This is a retrospective study of patients undergoing otolaryngologic surgery between January 2016 and April 2018 at Mbingo Baptist Hospital (MBH). Institutional review boards at the Johns Hopkins University School of Medicine and MBH approved this study.

2.1 | Setting

MBH is 310-bed and 6-operating room not-for profit referral teaching hospital located in a rural region of the Northwest Province of Cameroon. Nurses trained by the Director of Otolaryngology (E.A) staff 4 outpatient regional clinics and function as an effective triage and referral system. MBH is staffed by one Cameroonian otolaryngologist year-round (E.A.) and additional visiting otolaryngologists trained in head and neck surgery. MBH is equipped with pathology services, laboratory testing, an intensive care unit, and a computed tomography scanner. The otolaryngology service is capably equipped to perform fracture plating, laryngoscopy, bronchoscopy, esophagoscopy,

endoscopic sinus and skull base surgery, osteotomies, microscopic ear surgery, surgical airways and soft tissue resections.

Patients are typically seen in the otolaryngology clinic and admitted to the ward prior to surgery. Surgery is priced on a sliding scale, and roughly designed to cover the cost of anesthesia (50 000 Central African francs/hr or \$82 USD/hr) and surgical equipment required.

2.2 | Case log

Surgical cases performed by the otolaryngology service at MBH are recorded by hand in a log book. For this study, data extracted from the log book included year, home geographic area, sex, age, type of anesthesia, diagnosis, and surgery. Each logbook entry was treated as a single case, and multiple cases on the same patient at different entries were considered separate cases. Cases were assigned a specialty (general, head and neck, pediatrics, laryngology, otology, rhinology, plastics, trauma), and comparisons were made among categorical variables using Pearson's chi-squared tests. Data were collated and analyzed using Stata version 15.1 (College Station, Texas).

2.3 | Schema

The authors generated a leveling schema based on urgency and capacity for health improvement. This was developed in the following manner; an initial schema based off of clinical experience was generated based on discussion among the authors. The list of surgical cases was categorized using this schema, with indeterminate cases marked for review. Cases marked for review mostly included surgery for diagnosis that present in Cameroon as more advanced than they would have typically presented in a US-based hospital, and therefore required more clinical urgency. For example: ankylosing spondylitis, thyroid goiter, and fibrous dysplasia. Wording changes were made to the schema based on observations during this initial categorization, and the case categorization was performed a second time (Table 1).

3 | RESULTS

A total of 1277 otolaryngologic surgical cases took place at Mbingo Baptist Hospital during the dates of the study, averaging greater than 1 case per day. 98% of cases were performed under general anesthesia. The age range of patients was 0 to 83 (median 27) years, and the decade of age with the most cases performed was the <10 years decade, whereas 12% of cases were performed on older adults (>60 years). The case load comprised a similar proportion of male and female patients. The listed price of surgery ranged from 0 to 1 000 000 Central African francs (CAF, \$0-1647 USD). Patients represented 8 of the 10 regions of Cameroon, with three cases performed on patients from neighboring countries. Most patients were from the Northwest (397, 31%) or West (255, 20%) regions.

3.1 | Burden of surgical otolaryngologic disease

The subspecialty with the largest proportion of surgical cases was head and neck (517, 40%), followed by pediatrics (316, 25%) and

TABLE 1 Proposed schema for otolaryngology case triage in settings of extenuating circumstances or resource limitation

Level	Definition	Example cases
1	<i>Immediately life-saving</i> Timeline: hours	<ul style="list-style-type: none"> Tracheostomy for airway obstruction Control of hemorrhage Incision and drainage of deep space neck infection
2	<i>Life-changing</i> <i>Return to function</i> <i>Cancer resections likely to succeed</i> Timeline: days to weeks	<ul style="list-style-type: none"> Resection of cancer or suspected cancer Coronoidectomy for temporomandibular joint fixation from ankylosing spondylitis Open reduction and internal fixation of mandible fracture
3	<i>Improving function</i> <i>Cancer resections less likely to succeed</i> Timeline: months to a year	<ul style="list-style-type: none"> Excision of branchial cleft cyst Adenotonsillectomy for recurrent infection Endoscopic sinus surgery for nasal polyposis
4	<i>Cosmetic</i> Timeline: elective	<ul style="list-style-type: none"> Thyroid lobectomy for thyroid goiter Revision of scar Excision of lipoma

general (141, 11%), whereas otology only made up 5% of cases (Figure 1A). The most common case performed was tonsillectomy (n = 224), 63% of which were performed for tonsillar hypertrophy and 36% for infection. 42% of the tonsillectomies included adenoidectomy. After these procedures, the most frequent pediatric procedure performed was cleft lip and/or palate repair (61, 19%) and esophageal or airway foreign body retrieval (25, 8%).

Among head and neck cases, 77% (n = 400) were curative resections, and 17% (n = 87) were primarily diagnostic with the remainder revisional or temporizing (tracheostomy or debulking). The most common curative resection was thyroidectomy (n = 166, 41%) followed by mandibulectomy (42, 11%). Among the curative resections, 81 neck dissections were performed either concurrent with primary tumor resection (44) or separately (37) (Figure 1B).

Rhinology cases consisted of functional endoscopic sinus surgery for nasal polyposis (13, 24%) or other sinonasal masses (13, 24%) with pathology including inverted papilloma and Ewing's sarcoma. Seven endoscopic endonasal approaches to the anterior skull base were performed for resection of sellar masses.

Thirteen (10%) of the trauma cases were noted to be sequelae of gunshot wounds. The majority of trauma cases (78, 63%) were mandible fractures, mostly due to road traffic accidents. The vast majority of otology cases were tympanoplasties (49, 84%), with one case of tympanostomy tube placement. Laryngeal pathology consisted of papilloma (14, 41%), other benign masses (12, 35%), and stenosis (8, 24%). Plastics cases were comprised of scar revisions, benign cyst removals and resection of disfiguring bony growths. General cases included esophageal and airway foreign body removals in adults (7), infections including neck abscesses, Ludwig's angina, necrotizing fasciitis and osteomyelitis (42), and tracheostomy not specifically for

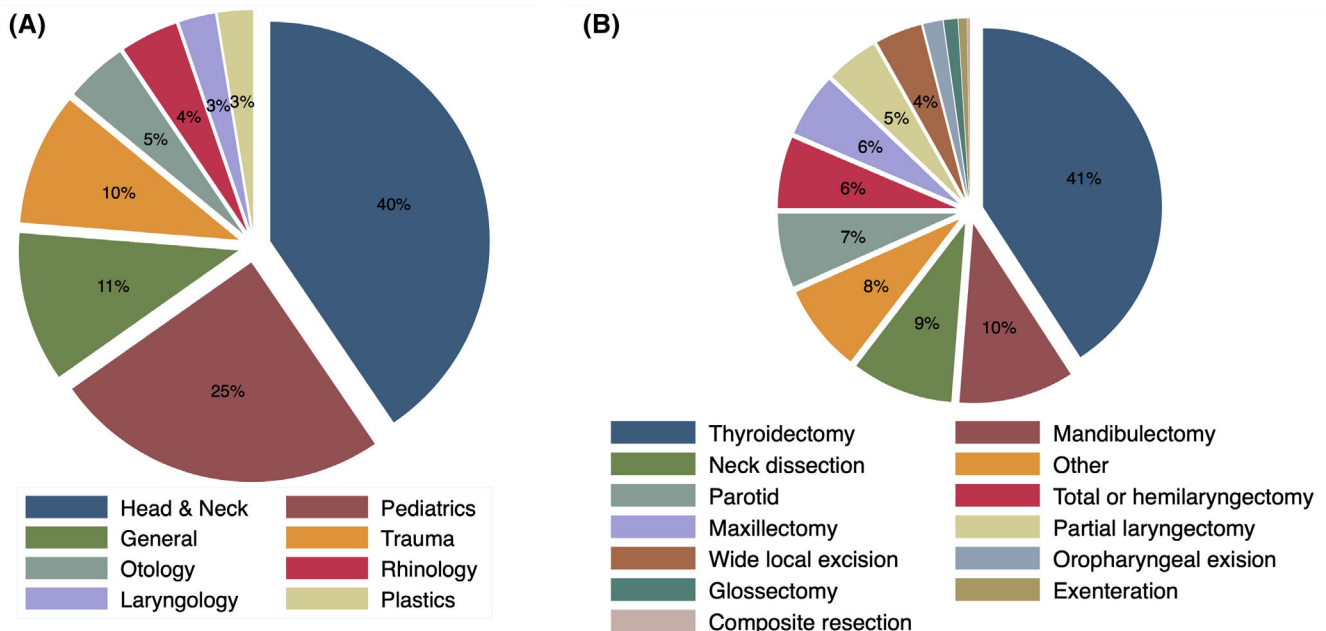


FIGURE 1 Distribution of otolaryngologic surgical cases at Mbingo Baptist Hospital, Northwest Cameroon. A, Distribution of surgical cases by specialty category. B, Distribution of type of curative head and neck cases

obstructing cancer (11). Among unique cases were coronoidectomies for temporomandibular joint ankylosis performed for patients with Treacher Collins syndrome (5), and tracheostomy for airway compromise secondary to tetanus and diphtheria.

The price of surgery differed significantly among specialty categories ($P < .001$), with trauma as the most expensive (median 300 k, IQR 120-400 k CAFs) followed by head and neck (median 250 k, IQR 150-300 k CAFs) and rhinology (median 232.5 k, IQR 150-300 k CAFs). The most expensive procedures (>500 k CAFs) were mandibular open reduction and internal fixation, total laryngectomies, and cases including pectoralis or free flaps. Laryngology cases were the least expensive (median 100 k, IQR 100-150 k CAFs).

The specialty distribution of cases differed significantly when comparing patients who were from the Northwest region compared to those who had travelled to MBH from outside the region ($P = .04$). A greater proportion of head and neck patients (275, 44%) travelled from outside the region compared to those within the region (139, 35%). The opposite was true of pediatrics—whereas 31% were local to the region, 23% travelled into the Northwest region for pediatric surgical care.

3.2 | Schema development

A four-tiered leveling system was generated on the basis of temporal urgency (hours, days to weeks, months to a year, elective), and relief of morbidity or prevention of future morbidity. Level 1 cases were considered immediately life-saving. Level 2 cases were considered life-changing, were expected to result in a significant return to functions of daily living, or would prevent future death due to cancer. Level three comprised cases that aimed to significantly improve quality of life including function, or cancer resections that were less likely to be curative. Level 4 comprised cases performed for purely elective cosmetic purposes, with the recognition that these cases may also yield improvements in quality of life. The schema with examples is included as Table 1.

3.3 | Application of schema

Next, the schema was applied to the case log dataset as determined by consensus of the authors. Multiple nuances were taken into consideration.

Categorization of thyroidectomy presented a major challenge, as this surgery is performed for multiple indications including cancer, thyrotoxicosis, compressive goiter, and asymptomatic but cosmetically unacceptable goiter. Given the limited detail in the operative log, consensus opinion was to consider total thyroidectomies as either diagnostic or therapeutic for cancer or a compressive goiter (level 2), whereas thyroidectomy for goiter was considered cosmetic (level 4). Thyroid lobectomies were specified for a “mass,” “cancer,” or due to toxicity were considered level 2.

Cancer resections that were less likely to be curative due either to the extent of disease or to the resource-limited context were

performed sparsely, with great consideration of the risk/benefit ratio, and often for young persons. Such resections were categorized as a level 3 priority to reflect the appropriateness of resource allocation below that of curative cancer resections. Free flap surgery is resource-intensive and not routinely performed at MBH, implying the decision to proceed reflected a particularly critical patient condition with limited reconstructive options and unique availability of a microvascular surgeon. For these reasons, the few free flap reconstructions (8) were considered level 3.

The majority of surgical cases at MBH were deemed to be Level 2 (661, 52%), followed by Level 3 (388, 30%), 1 (12%), and 4 (6%) (Figure 2). Levels differed by specialty category ($P < .001$). Level 1 was mainly comprised of general (41%), Level 2 largely of head and neck (63%), level 3 pediatrics (53%) and Level 4 plastics (23%) and head and neck (56%) cases.

Price differed significantly by level ($P < .001$), with level 1 cases as the least expensive (median 90 k, IQR 30-150 k) and level 4 as the most expensive (median 250 k, IQR 150-300 k). Level did not differ by patient geographic location of origin.

4 | DISCUSSION

This is the first study describing the surgical otolaryngologic disease burden in a resource-limited setting in Sub-Saharan Africa. We found a dominant burden of head and neck cancer, adenotonsillar disease, and cleft lip and palate. We also propose and apply a novel, otolaryngology-specific surgical leveling schema for use in resource allocation in low and middle income countries (LMIC) as well as health systems worldwide facing states of emergency such as the SARS-CoV-2 pandemic.

In Cameroon, there are an estimated 25 otolaryngologists⁴ serving a population of 25 million. It is the authors' experience that most of these providers are in urban areas and working in the private sector—the major geographical distributional inequalities of health

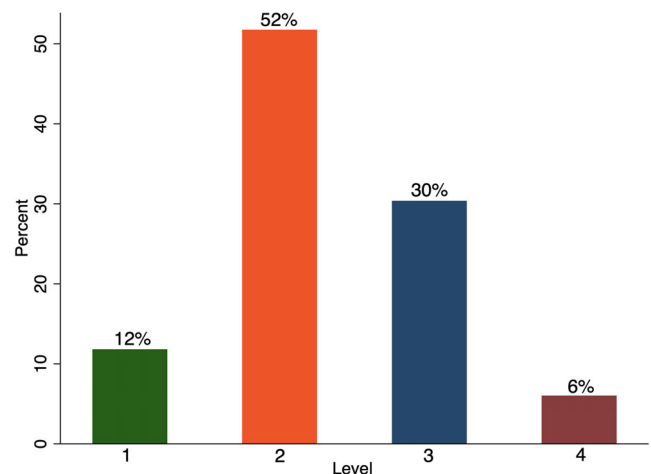


FIGURE 2 Distribution of case level at Mbingo Baptist Hospital, Northwest Cameroon using proposed schema

workers in Cameroon have been described.⁵ Few prior studies describe otolaryngology in LMIC compared to developed health systems. The otolaryngologic condition causing the greatest public health burden in LMIC is hearing loss,⁶ attributable to lack of childhood screening, lack of specialty care, and as a sequela of communicable disease given limited access to prenatal care and vaccines.⁷ Disability due to trauma disproportionately affects LMIC,⁸ including the burden of facial trauma. Furthermore, infectious disease plays a role, as it is estimated that 80% of HIV-positive and many patients with tuberculosis have otolaryngologic manifestations.

Importantly, it is projected that 70% of the worldwide burden of cancer will be in the developing world by 2030. This is thought to be due to the rise of tobacco and alcohol use, and increasing life expectancy.⁹ In developed countries, the incidence of head and neck squamous cell cancers is decreasing and has largely been superseded by the emergence of oropharyngeal cancers due to human papillomavirus.¹⁰ In comparison, smoking rates are high and the incidence of oropharyngeal cancer and oral HPV infection in Cameroon have been found to be low, portending a rise in smoking-related cancers.¹¹ Head and neck cancer presents a unique challenge as its treatment requires anatomic, functional and reconstructive considerations, specialty training beyond general surgery, nurses trained in surgical airways, specialized nutrition in patients with dysphagia, and multidisciplinary treatment when available. There is a paucity of radiation machines in Africa, and chemotherapy is often cost-prohibitive, shifting management to primary surgery where curative.¹²

Most cases in our study were in the head and neck subspecialty category, and those travelling into the region were disproportionately head and neck patients. Our findings corroborate previous literature describing the need for surgeons trained in head and neck surgery in LMIC.¹² The current lack of otolaryngology training programs in Sub-Saharan Africa is not expected to produce a sustainable workforce.⁴ With the wide global disparity in cancer-related deaths based on wealth and as the population in LMIC ages,¹² resource allocation to head and neck cancer care with attention to quality surgical training is paramount.

The second most common case performed during our study was thyroidectomy. Sub-Saharan Africa is recognized to harbor a high rate of thyroid disease, as a sequelae of nutritional deficiencies and consumption of cassava root. Thyroid surgery for goiter in resource-poor settings is considered to have acceptable outcomes and has been shown to significantly improve quality of life.¹³ Despite this, thyroidectomy carries the risk of life-threatening complications, and requires adequate surgical training to be performed safely.

A surprising finding was the relatively small proportion of otology cases, with only a single case of tympanostomy tube placement. The frequency of tympanoplasty implies a burden of chronic suppurative otitis media that may have been successfully addressed earlier with tympanostomy tube placement. Hearing loss was ranked fifth in a list of causes of years lived with disability in the Global Burden of Disease Study 2013.¹⁴ Although not always a surgical disease, pediatric hearing loss due to chronic otitis media is a significant detriment to development and can often be treated with tympanostomy tubes. The low

rate of tube placement is likely a due to lack of consistent pediatrician visits for otitis media that would establish a referral pattern for surgery for recurrent cases. Though the otolaryngology service of MBH does have audiologic screening capability, there is no nationalized hearing screening program in Cameroon. In contrast to cost-intensive cochlear implantation, centralized screening for and treatment of chronic otitis media represents an area for improvement that may be achievable at low cost in low-resource settings.

The SARS-CoV-2 pandemic induced a setting of resource limitation on health systems around the world. In the United States, the American College of Surgeons³ and the American Academy of Otolaryngology—Head and Neck Surgery¹⁵ alike urged the triage of surgical cases. Despite this, little guidance was provided on how to proceed and otolaryngology leadership have resorted to de novo leveling systems. The pandemic required not just determination of which cases are emergent or urgent, but also the gradations along the spectrum from urgent to elective used to inform the order of cases as systems underwent stepwise reopening to elective surgeries. Herein, we propose a four-tier leveling system based on recommended time to surgery and impact on health. The difference between our leveling system as it applies to developed health systems is that resource allocation with regard to cost of care may be less important, as the limitations on resources among developed systems speak more to the shortage of personal protective equipment, testing, and ICU bed availability than the scarcity of specialized surgeons and equipment.

Surgical case schema have been previously proposed by the World Health Organization Lancet Global Commission on Surgery and *Médicins Sans Frontières*. While the former separates cases by “Must do,” “Should do,” and “Can do” and applies mainly to characterize hospitals, the latter uses a three-tiered leveling schema (Urgent, Delayed, Planned elective) to triage general, obstetric and orthopedic surgery during times of war, epidemics, natural catastrophe or unacceptable living standards.¹⁶ Neither framework naturally applies to the broad scope of practice of otolaryngology. Our schema is not only straightforward, it captures the breadth of urgency in otolaryngology.

It is unclear if use of this schema would have influenced the order in which the cases were performed or the time from presentation to surgery. We propose that its uses would include not only resource allocation, but also ground-level hospital operations. By providing a common language among the attending surgeon, surgical team, and other hospital staff with which to discuss the triage of upcoming cases, our schema could improve flow as well as manage patient expectations. This language is particularly important in otolaryngology, where an unsightly thyroid goiter is elective whereas soft stridor and fever can portend impeding airway blockage. Ultimately, the schema may improve the time from presentation to intervention. Future work can focus on the prospective application and validation of this schema in various settings.

There are limitations to our study. First, the log included limited information regarding diagnosis and surgery, requiring the authors to interpret and in some cases assume benignity or malignancy. We describe findings from a single hospital in rural Cameroon, which may

not be representative of other resource-limited settings. Particularly, the cases performed are likely subject to and impacted by the resources available at MBH and are only an indirect representation of otolaryngologic disease in the region.

5 | CONCLUSION

We present a descriptive analysis of the burden of surgical otolaryngologic disease in a resource-limited setting in Sub-Saharan Africa, with a focus on the significant burden of head and neck cancer. Our findings may assist with resource planning, including specialized operative equipment and training programs for African surgeons in otolaryngology—head and neck surgery. We propose a novel case-leveling schema appropriate for use in otolaryngology in resource-limited settings or hospital systems worldwide facing states of emergency.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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