

# Perioperative care capacity in East Africa: results of an Ethiopian national cross-sectional survey

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**Background:** Provision of safe surgery has gained focus recently. In 2015, the World Health Organization (WHO) called for the strengthening of surgical and anesthesia services as a universal health coverage component. The same year, the Ethiopian Ministry of Health (MOH) launched the “Saving Lives through Safe Surgery” initiative to prioritize and scale-up surgical services. This study provides an updated overview of perioperative facilities’ status to facilitate the identification of future focus areas.

**Methods:** An online national cross-sectional survey was conducted in September–November 2020, incorporating elements from recognized surgical and anesthesia facility assessment tools to assess infrastructure, workforce, and availability of resources across Ethiopian government facilities.

**Results:** Responses were received from 81/289 (28%) facilities, conducting a mean of 6.9 (range: 1–37) surgeries per day. All regions were represented. There were shortages in specialty surgical, obstetric, and anesthesiology workforce, functioning anesthesia machines, airway equipment, recommended monitoring devices, and capnography. Shortages of analgesia, anesthesia, and emergency medications were reported. Sixty-eight (84%) facilities had a postanesthetic care unit with a mean of 3.1 (range: 1–15) beds. The presence of trained nurses, oxygen, monitoring devices, equipment, medications, and postoperative care guidelines was minimal.

**Conclusions:** This study provides an updated overview of surgical capacity in Ethiopia. Despite the expansion of surgical access, there are ongoing resource deficits. Expansion of surgical capacity should be accompanied by a similar expansion in the provision of adequately equipped and staffed postanesthetic care units and a focus on postoperative care.

**Keywords:** Global surgery, Surgical capacity, Surgical workforce, Postoperative, Anesthesia

## Key points

- This study provides an up-to-date overview of Ethiopian perioperative facilities’ status.
- A review of surgical infrastructure, service, workforce, resources, and guidelines.

- Despite expansion of surgical services, there are ongoing widespread resource deficits.
- The presence of adequately equipped and staffed postanesthetic care units (PACUs) is minimal.

## Introduction

Perioperative care extends from preoperative evaluation and optimization to postoperative strategies. Traditionally, surgery was deemed to be confined to the intraoperative phase; however, critical incidents in the postoperative phase have led to equal emphasis now being given to the overall patient journey<sup>[1,2]</sup>. The increasingly recognized need for improving surgical care globally, coupled with a raised understanding of the need for a coordinated approach to this, means perioperative care is no longer considered the role of a single specialty. Surgery is gaining attention from a broader global health perspective, including public health experts, researchers, policymakers, stakeholders, surgical and anesthesia practitioners, and patients<sup>[3,4]</sup>.

An estimated 5 billion people lack access to surgical care when needed, with a significant proportion of these residing in low and middle-income countries (LMICs). Provision of safe surgery has gained considerable focus in recent years, with shortfalls in access to surgery highlighted in the report of the Lancet Commission on Global Surgery<sup>[5]</sup> and inequalities in outcomes reported in the African Surgical Outcomes Study<sup>[6]</sup>. Despite increasing awareness, the emphasis on improving perioperative care remains limited, confounded by a scarcity of perioperative data<sup>[5,7]</sup>.

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Perioperative mortality is higher in LMICs<sup>[8]</sup>, and surgical patients in Africa at increased risk<sup>[6]</sup>. Surgery and anesthesia are interconnected—anesthesia-related mortality in Sub-Saharan African countries is also higher than in high-income countries<sup>[9–12]</sup>, and improving anesthesia services has been identified as a global health priority<sup>[13]</sup>. There is significant variability of conditions in which anesthesia is provided in LMICs, numerous varying anesthesia training programs<sup>[14]</sup>, and a recognized shortage of physician anesthesia providers<sup>[15]</sup>.

In 2015, the World Health Organization (WHO) member states adopted World Health Resolution 68.15, calling to strengthen surgical and anesthesia services as a component of universal health coverage<sup>[16]</sup>. The same year, the Ethiopian Ministry of Health (MOH) launched the national initiative, Saving Lives through Safe Surgery (SaLTS), and the Safe Surgery 2020 program was also launched in Ethiopia, a multipartner, a multicomponent program focused on expanding safe surgical care (<https://www.safesurgery2020.org>). Through national prioritization of surgical and anesthesia care, considerable scale-up of surgical services has occurred. This has included: increasing surgical operating capacity, expanding graduate programs for surgical and anesthesia training, preparing a national surgical plan, developing a national hospital assessment tool and key performance indicators, coupled with monitoring and evaluation strategies (<https://www.pgssc.org/ethiopia>)<sup>[17,18]</sup>.

Ethiopia is the second-most populous region in Africa; a federalist state with 10 regions and 2 administrative cities. Currently, the number of governmental surgical facilities is estimated to be 289. However, this number is progressively increasing as part of the national surgical plan to expand emergency surgical access availability. In 2019, the number of surgeries per 100,000 people was 465 in Ethiopia (Ethiopian MOH, personal communication, December 2020), a > 10-fold increase from 2012<sup>[19]</sup>, and greater than a rate of 144.5 per 100,000 reported in neighboring Uganda in 2019<sup>[20]</sup>. The goal set by the Lancet Commission on Global Surgery is 5000 surgical procedures per 1000,000 population by 2030<sup>[5]</sup>.

The Network for Perioperative and Critical care (N4PCc) is working collaboratively with the Ethiopian MOH SaLTS initiative, academic institutions, professional associations, and similar networks with a shared vision. The network envisions creating a collaborative system for improving perioperative care in Ethiopia<sup>[21]</sup>. The N4PCc group conducted this study to provide evidence for policymakers, administrators, academics, philanthropists, and stakeholders to improve perioperative care in Ethiopia by conveying insight into the current status of national government-run perioperative facilities to enable the identification of priority focus areas going forward.

## Methods

The authors conducted an online national cross-sectional survey, created through a consultative process incorporating elements from existing tools, including the Safe Surgery Hospital Assessment Tool<sup>[22]</sup>, World Federation of Societies of Anaesthesiologists (WFSA) Anaesthesia Facility Assessment Tool<sup>[23]</sup>, and the Lancet Commission on Global Surgery Surgical Assessment Tool<sup>[24]</sup>. These tools have some similarities, yet differences in focus or specialty area; hence the authors utilized all 3 tools when selecting components for the final survey to create a comprehensive survey tool. The authors then grouped the survey questions into the

following themes: infrastructure, human resources, service delivery, and the availability of medications, equipment, and guidelines. Although often incorporated into surgical capacity assessments, the authors agreed not to include financing due to its sensitive nature.

The final quantitative survey included 77 checkbox questions, avoiding open responses, for clarity and ease of completion. Utilizing Google Survey software, the authors created and administered the survey to a convenience sample of government hospitals providing surgical services from September to November 2020. The authors excluded private facilities, opting to focus on public services.

The online survey link was sent via email and/or telegram social media to N4PCc collaborators at each site. All collaborators are perioperative practitioners (anesthesia providers, surgeons, obstetricians, nurses) at their respective institutions. In any facilities with no N4PCc collaborator, contact was made via the department of anesthesia at each institution. Telephone follow-up was conducted with nonresponding hospitals in November 2020 to overcome barriers to completion, including assistance with data input where internet connections were a barrier to survey access.

Quantitative survey data were analyzed descriptively using Microsoft Excel.

Ethical approval for this study (protocol number 153/01/01) was obtained from Debre Birhan University Institutional Review Board, Debre Birhan, Ethiopia, on July 21, 2020. This work has been reported in line with the STROCCS criteria<sup>[25]</sup> and is registered with a research registry, unique identifying number ChiCTR2100042594.

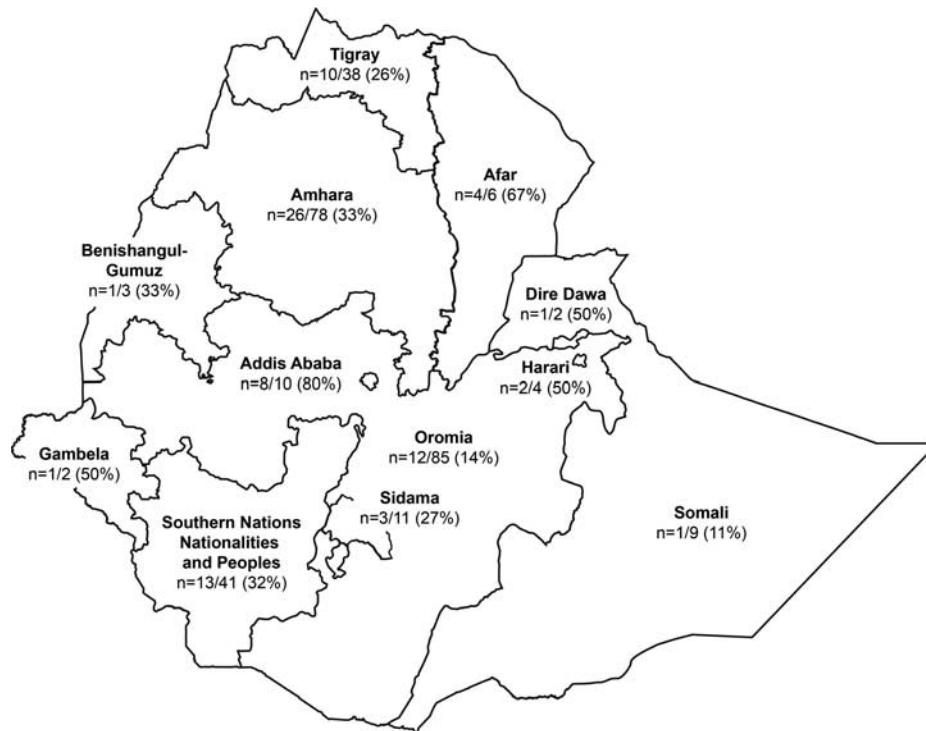
## Results

Responses were received from surgical facilities within all 10 administrative regions and 2 chartered cities in Ethiopia. A total of 81/289 (28%) hospitals completed the survey, including all regions (Fig. 1). Somali and Oromia were the least represented regions. Ethiopia has a 3-tiered health system; responding institutions included 28 (34.6%) primary level, 26 (32.1%) secondary/general level, and 27 (33.3%) tertiary/referral level hospitals; 25 (30.9%) of tertiary level hospitals were teaching centers affiliated with academic institutions.

The 81 facilities represented 2459 surgical beds, plus an additional 1651 obstetrics and gynecology beds (total surgical plus obstetrics and gynecology: 4110 beds); 1512 (61.4%) were referral level, 693 (28.1%) general hospital level, and 254 (10.3%) primary level. Responding facilities reported 257 operating tables, a mean of 3.2 (range: 1–15) tables. Of these, 152 (59%) were within a referral level hospital, 71 (27.6%) at a general level, and 34 (13.2%) at the primary level.

Among the surveyed hospitals, 30 (37%) facilities had an anesthetic preoperative assessment clinic, 68 (84%) had a PACU, and 39 (48%) had an intensive care unit. In facilities with a PACU, the mean number of beds was 3.1 (range: 1–15). Seven (8.6%) facilities had no backup generator for electricity supply. No facility had piped oxygen, although all had cylinder oxygen available in the operating room (OR).

Facilities reported performing a mean of 6.9 (range: 1–37) surgeries per day. Twenty-three (28.4%) facilities had no specialty surgical workforce, with nonobstetric emergency surgery performed by Integrated Emergency Surgical Officers (IESOs).



**Figure 1.** Distribution of surgical facilities and responding sites.

For obstetric procedures, 25 (30.9%) facilities had no specialist obstetric workforce and relied on IESOs. Only 30 (37.9%) facilities reported having a subspecialist surgical workforce; these were mainly concentrated in urban areas. The majority (63; 77.8%) of facilities did not have a physician anesthesiologist, with nonphysician anesthesia providers (NPAPs) covering anesthesia services in these facilities. Only 31 (38.2%) facilities had a sufficient anesthesia workforce to enable 1 provider to be assigned per OR table. The surgical and anesthesia workforce distribution is displayed in **Table 1**.

A significant proportion of facilities had anesthesia students present (53; 65.4%), and some had surgical residents (23; 28.4%). Within the 68 facilities with a PACU, 21 (25.9%) had trained PACU nurses. Three (3.7%) facilities had no dedicated PACU nursing staff. In 38/68 (55.9%) PACU facilities, the nurses had not received basic life support training. The nurse ratio to a patient in the PACU was a minimum of 1:2 in 22 (32.4%); in the remaining 46 (67.6%), 1 nurse would oversee all patients. Five (7.4%) PACUs had an assigned anesthesia provider responsible for the PACU.

A functioning anesthetic machine was available in each OR in 74 (91.4%) responding facilities. Shortages of airway adjuncts such as laryngeal masks and oropharyngeal airways were noted (**Fig. 2**). Internationally recommended monitoring devices (pulse oximetry, electrocardiogram, and blood pressure/sphygmomanometer) were all available in the operating suites of 68 (83.9%) hospitals. Twelve (14.8%) hospitals had some but not all of these devices. In 62 of the 68 (91.2%) hospitals with all the recommended monitoring devices, this was available at all OR tables; in 6 (8.8%), these devices were shared between tables. Although suction was available, this was shared between anesthesia and surgery in 37 (46.8%) and 37 (54.4%) PACUs shared suction

with the OR. The presence of oxygen, monitoring devices, and emergency equipment in the PACU was more limited than in the OR (**Table 2**). Anesthetic and emergency medication availability was limited (**Table 3**). Whole blood was the only available blood

**Table 1**  
Availability of surgical and anesthesia workforce.

Discipline	Addis Ababa (N = 8/10 Facilities)	Other Regions (N = 73/279 Facilities)
Anesthesia		
Anesthesiologist	23	14
Anesthesia (MSc)	19	136
Anesthesia (BSc)	161	440
Nurse anesthetist	2	76
Surgery		
General surgery	131	232
Obstetrics/gynecology	44	164
IESO	10	127
Surgical subspecialty		
Cardiothoracic	2	3
Ear, nose, and throat	3	11
Orthopedics	6	18
Hepatobiliary	3	4
Maxillofacial	2	9
Neurosurgery	5	10
Pediatric surgery	2	4
Urology	3	12
Vascular	2	0
Total subspecialists	28	71

BSc indicates Bachelor of Science; IESO, Integrated Emergency Surgical Officer; MSc, Master of Science.

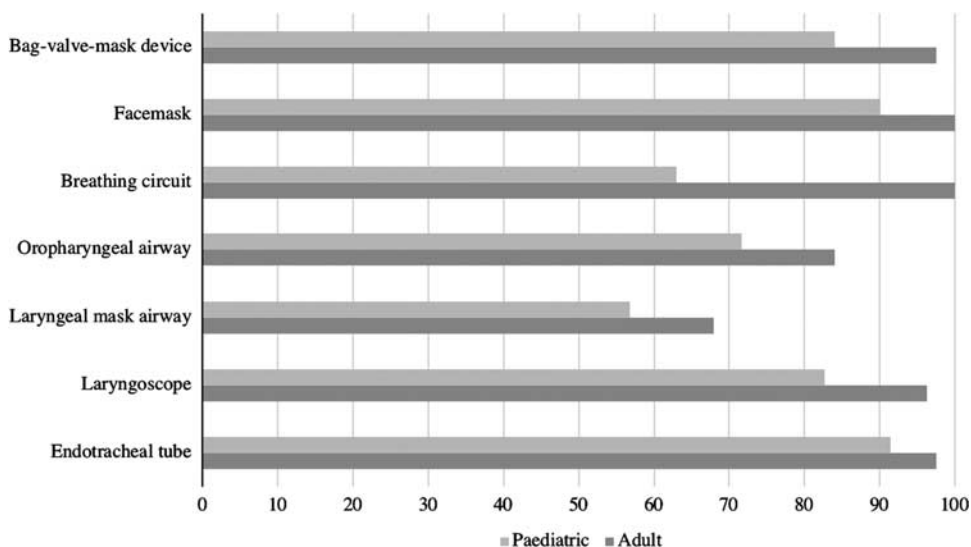


Figure 2. Availability of airway equipment (% facilities).

product; in 13 (16%), this was not available for immediate use in the case of emergency.

Use of the WHO Surgical Safety Checklist was reported in 70 facilities (86.4%) and perioperative morbidity and mortality reviews in 55 (67.9%). An operating log was kept in 75 (92.6%). The availability of guidelines for postoperative care was limited (Table 4). Medications were available in the PACU to treat pain, postoperative nausea, and vomiting, and in case of emergency in 55 (80.9%), 42 (61.8%), and 41 (50.6%) facilities, respectively.

**Discussion**

In Ethiopia, surgical capacity assessments, conducted in 2011<sup>[26]</sup> and 2016<sup>[27]</sup>, have reported deficits in infrastructure, service delivery, workforce, information management, finance, equipment, and pharmaceuticals. This study provides an updated overview of surgical capacity across the country and highlights that there are ongoing shortages of a specialist workforce and resources despite the expansion of surgical access.

**Table 2**  
Availability of monitoring and equipment in the operating room (OR) and postanesthesia care unit (PACU).

Monitor/Equipment	n (%)	
	Available in Facility OR (N = 81)	Availability in Facility PACU (N = 68)
Pulse oximetry	81 (100)	68 (100)
Electrocardiogram	69 (85)	27 (39.7)
Sphygmomanometer	81 (100)	63 (92.6)
Thermometer	56 (69)	31 (45.6)
Capnography	27 (33)	4 (5.9)
Nerve stimulator	3 (3.7)	3 (4.4)
Defibrillator	20 (24.7)	5 (7.3)
Suction machine	81 (100)	68 (100)
Cylinder oxygen	81 (100)	48 (70.6)
Oxygen concentrator	38 (46.9)	38 (55.9)

The reported numbers of surgeons, anesthesiologists, and NPAPs in this survey indicate growth in the workforce since the 2016 WFSA global anesthesia workforce survey<sup>[15]</sup>, particularly at the NPAP level. Yet, the majority of surgery is provided by IESOs and NPAPs working without assistance and/or supervision.

The WHO-WFSA International Standards for a Safe Practice of Anaesthesia<sup>[28]</sup> set out a series of recommendations for personnel, equipment, medication, monitoring, and conduct of

**Table 3**  
Availability of medications in the operating room (OR).

Medication Type	Medication Name	Availability in Facility OR, n (%)
Induction agents	Ketamine	81 (100)
	Thiopentone	73 (90.1)
	Propofol	58 (71.6)
	Etomidate	2 (2.5)
Muscle relaxants	Suxamethonium	78 (96.3)
	Vecuronium	70 (86.4)
	Pancuronium	54 (66.7)
	Atracurium	5 (6.2)
	Mivacurium	0 (0)
	Rocuronium	0 (0)
Volatiles	Halothane	81 (100)
	Isoflurane	34 (42)
	Sevoflurane	2 (2.5)
	Desflurane	0 (0)
	Nitrous oxide	0 (0)
Opioids	Pethidine	66 (81.5)
	Morphine	34 (42)
	Oxycodone	0 (0)
	Fentanyl	14 (17.3)
Emergency medications	Alfentanil	0 (0)
	Adrenaline	75 (93)
	Atropine	81 (100)
	Ephedrine	5 (6.2)
	Phenylephrine	3 (3.7)
	Dopamine	39 (48.1)
Dantrolene	4 (4.9)	

**Table 4**  
**Availability of postoperative care guidelines.**

Guideline	Availability, n (%)
Patient transfer/handover	24 (29.6)
PACU care	19 (23.5)
PONV management	16 (19.8)
Acute pain assessment	21 (25.9)
Postoperative pain management	20 (24.7)
PACU discharge criteria	18 (22.2)

PACU indicates postanesthesia care unit; PONV, postoperative nausea and vomiting.

anesthesia. This survey reports the “highly recommended” standards are not consistently met in facilities in Ethiopia. Although many essential items of equipment and monitoring devices are widely available, their number is often insufficient, and items continue to be shared between the OR and PACU, between ORs, patients, and personnel. Pulse oximetry was widely available in responding facilities, indicative of the success of projects highlighting the need for this essential monitoring device, such as the Global Oximetry Project<sup>[29]</sup> and its inclusion in the WHO Guidelines for Safe Surgery<sup>[30]</sup> and WHO Surgical Safety Checklist, which was also noted to have high levels of use.

Despite widespread endorsement in high-income countries, capnography, essential to detect airway complications such as esophageal intubation, is often unavailable in LMICs, and improving access may improve patient safety worldwide<sup>[31]</sup>. High costs, lack of provider training on its use, and lack of devices designed for low resourced environments have been limiting factors, and a call to action to address the global capnography gap has been made<sup>[32]</sup>. In this study, capnography was available in only a third of responding facilities.

Although airway equipment to enable intubation and ventilation was widely available, airway adjuncts were not. These items are important when managing a difficult airway, in difficult ventilation, and failed intubation scenarios. Sub-Saharan countries are home to a large pediatric population, with a reported risk estimation for surgical conditions as high as 85.4%<sup>[33]</sup>. This demand, coupled with high rates of anesthetic-related mortality in children in LMICs<sup>[34]</sup>, highlights a need to focus on the safety of pediatric anesthesia services in LMICs, including pediatric equipment provision. Limited pharmaceutical availability was also noted, particularly with reference to the range of agents available; greater provision is necessary to improve patient and condition appropriate agent selection, and management of complications and emergencies.

Perhaps the most pertinent findings of this survey relate to postoperative care. The evolution of PACUs over several decades has embedded their role as an essential component of surgical care. With the recognition of the majority of complications occurring in the postoperative period<sup>[6]</sup>, any expansion in surgical capacity must be accompanied by a similar expansion of postoperative care. Events occurring postoperatively can lead to worse outcomes than those occurring intraoperatively<sup>[35]</sup>. Early studies highlighting the importance of quality postoperative care reported adverse events occurring in PACUs between 5% and 30%<sup>[36–39]</sup>. In up to 39% of postoperative adverse events, improved monitoring might have prevented complications<sup>[36]</sup>. The PACU role has subsequently evolved from simple observation to a dedicated area with the ability to impact postoperative

outcomes. Despite this recognized need, the availability of PACUs in LMICs remains limited, their infrastructure variable, and their impact in reducing morbidity and mortality unknown.

Although 84% of facilities had a PACU, nursing ratios were limited, recovery nurses untrained, and shortages of monitoring devices, emergency equipment, medications, and guidelines were reported. This represents a significant area for improvement. Aligned with interventions to improve surgical and anesthesia care quality, postoperative care must be included; provision and expansion of adequately equipped recovery units, with dedicated and trained personnel, should accompany existing and future safe surgery programs.

The authors recognize that this study does not include all facilities within Ethiopia. The ability to include all sites was limited by response rates, communication difficulties, and travel-related challenges. However, the sample includes facilities of all levels within all regions, thus providing a reasonable representation of nationwide government facility status. The study excluded private and nongovernmental organization facilities. Common with survey data, accuracy is dependent on thorough and reliable completion. Through utilizing the N4PCc network, attempts were made to overcome barriers to completion and optimize data accuracy.

Our study comes at a prominent point, following the expansion of surgical capacity aligned with a national initiative, and provides an up-to-date overview of surgical services across Ethiopia to identify future focus areas. Despite this expansion of surgical access, there are ongoing resource deficits in surgical services throughout Ethiopia.

The shortage of specialty workforce needs to be addressed by the opening of more surgical and anesthesia specialty and subspecialty programs at teaching institutions. Provision of training opportunities for NPAPs and IESOs is also equally important as they constitute a large proportion of the workforce. It would be prudent to create national training manuals and courses for perioperative caregivers, especially nursing staff, and incorporate perioperative care in current curricula. Procurement of basic equipment and consumables is necessary, and nationally agreed-upon perioperative guidelines and audit tools should be developed.

All of this requires collaboration among teaching institutions, professional associations, international organizations, and the MOH, supported by evidence generated from routine perioperative data collection, and promotion of academia. Most importantly, expansion of surgical capacity should be accompanied by a similar expansion and focus on postoperative care.

### Ethical approval

Obtained from Debre Birhan University Institutional Review Board, protocol no. 153/01/01.

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None.

### Author contribution

F.K.: helped in conceptualization, methodology, investigation, project administration, software, data curation, validation,

preparation of the original draft of this manuscript, and presentation and visualization. K.D.B.: helped in conceptualization, investigation, methodology, data curation, validation, and reviewing and editing of this manuscript. B.Z.B., H.T.D., and D.B.T.: conducted the investigation, methodology, and reviewing and editing of this manuscript. F.B.K. and M.G.T.: helped in the investigation and provision of resources. E.B.W.: helped in the investigation, provision of resources, and software. T.B.G.: helped in the investigation, validation, and reviewing and editing of the manuscript. J.M.: helped in conceptualization, methodology, investigation, project supervision, preparation of the original draft, reviewing and editing, presentation and visualization.

### Conflicts of interest disclosure

The authors declare that they have no conflict of interest with regard to the content of this report.

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Jolene Moore.

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