Establishment of Mongolia's first independent and sustainable minimally invasive general thoracic surgery program: A Mongolian-Canadian initiative

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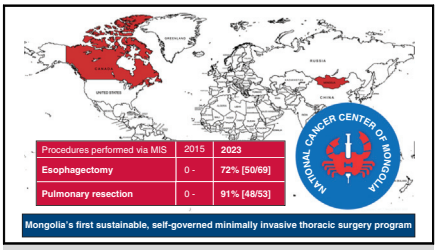
ABSTRACT

Objective: The advent of video-assisted thoracoscopic surgery in Mongolia has faced funding and accessibility challenges, leading to languid adoption. A Mongolian-Canadian collaboration was inaugurated to support the development of a self-sustainable, self-governed minimally invasive thoracic surgery (MITS) program in Mongolia.

Methods: A multidisciplinary Canadian thoracic surgery team collaborated with the National Cancer Center of Mongolia Thoracic Surgery service from 2016 to 2023. The team engaged in patient rounds, MITS procedures, and service education. Program and patient outcomes were reviewed.

Results: Thirty-four patients underwent MITS procedures as part of the Mongolian-Canadian collaboration. Median age was 51 years (range, 16-76 years), and 41% (14 out of 34) were men. Lung, esophageal, and mediastinal procedures composed 50% (17 out of 34), 21% (7 out of 34), and 21% (7 out of 34) of procedures, respectively. Conversion rate, median operative time, and hospital length of stay were 0%, 172.5 minutes, and 8 days, respectively. The complication rate was 9% (3 out of 34) with 3% (1 out of 34) being Clavien-Dindo >3 requiring re-operation. Thirty-day mortality was 0%. Mongolia's thoracic surgery team progressed from surgical assists to primary operators and a self-governed program. In 2023, the National Cancer Center of Mongolia's thoracic surgery service independently conducted 72% (50 out of 69) of esophagectomies and 91% (48 out of 53) of pulmonary resections via minimally invasive technique compared with 0% in 2015.

Conclusions: The Mongolian-Canadian collaboration demonstrated successful transfer of MITS proficiency through global noncolonialist surgical partnership, consequentially shifting the national thoracic surgical paradigm. Continued collaboration will focus on sustainability and supporting local surgeons in regional dissemination of MITS proficiency with the aim of globalizing thoracic surgical excellence. (JTCVS Open 2024;22:521-7)



Mongolia's first sustainable, self-governed minimally invasive thoracic surgery program.

CENTRAL MESSAGE

The Canadian-Mongolian MITS collaboration demonstrated feasibility and safety of developing the first self-sustainable, self-governed MITS program in Mongolia.

PERSPECTIVE

Thoracic surgical care has one of the highest disparities among low- and high-income countries, calling for international collaboration to address this inequity. The multidisciplinary Mongolian-Canadian partnership drastically altered Mongolia's standard of thoracic surgical care, allowing for 72% of esophagectomies and 91% of pulmonary resections to be done via MIS approach in 2023, compared with none via MIS in 2015.

See Discussion on page 528.

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Abbreviations and Acronyms

MCTSC = Mongolian-Canadian thoracic surgery collaboration
MIS = minimally invasive surgery
MITS = minimally invasive thoracic surgery
NCCM = National Cancer Center of Mongolia
VATS = video-assisted thoracoscopic surgery
WHO = World Health Organization

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Mongolia ranks 132nd on the World Health Organization's (WHO)'s life expectancy ranking,[1] at 68.1 years average life expectancy years per the most recent national data, with male and female life expectancy being 63.8 and 72.8 years, respectively.[2] Lung cancer is the third most common malignancy in Mongolia and contributes the third most cancer-related deaths.[3] Mongolians claim the highest incidence of esophageal cancer and associated age-standardized cancer deaths in the Asia Pacific region,[4] which is underpinned by diagnosis at a later stage and limitations in national health services.[5] Mongolia ranks in the WHO's top-30 nations in terms of tuberculosis burden,[6] subsequently leading to a high prevalence of pulmonary aspergilloma, for which surgical resection is a mainstay of therapy.[7] Video-assisted thoracoscopic surgery (VATS) is now well established around the world and is no longer considered as an emerging or new approach. Rather, minimally invasive surgery is the conventional approach for the majority of thoracic procedures in major surgical centers around the world, whether through video-assisted thoracoscopy or robotic surgery. Minimally invasive thoracic surgeries (MITS) have been shown to be noninferior to open procedures in terms of safety and oncologic outcome and have been shown to decrease hospital length of stay, costs, and patient morbidity.[8-10] Despite the disproportionate prevalence of thoracic surgical pathology, Mongolia is serviced by only 5 thoracic surgeons, none of whom were formally trained in VATS before 2016.

Mongolia's first case of minimally invasive surgery (MIS) was a laparoscopic cholecystectomy performed through a collaborative effort among Mongolian and American surgeons in 2003, funded by the Japan International Cooperation Agency. As greater access to laparoscopic equipment and surgical training propagated over the following decade, the first minimally invasive nephrectomy, distal pancreatectomy, splenectomy, and colectomy took place from 2009 to 2011. Mongolia's first VATS case was performed in 2010, marking the inauguration of a novel stage in the country's management of thoracic surgical disease and surgical proficiency. In response to the unique challenges in Mongolian thoracic surgery, the Mongolian-Canadian Thoracic Surgery Collaboration (MCTSC) was established in 2016 by the Surrey Hospital Division of Thoracic Surgery and the National Cancer Center of Mongolia (NCCM), seeking to cultivate and enhance the nation's MITS program with emphasis on technical proficiency, perioperative excellence, and self-sustainability. The purpose of this article is to describe the implementation of the MCTSC and its subsequent successes in developing Mongolia's sustainable thoracic surgical ecosystem.

METHODS

A multidisciplinary Canadian thoracic surgery team was composed of 1 thoracic surgeon (A.S.A.), 1 anesthesiologist, and a group of operating room nurses, a nurse practitioner, and a physiotherapist. The team collaborated with the NCCM thoracic surgery service from 2016 to 2019 and 2022 to 2023, during which the Canadian team visited Mongolia for 1-week-long periods. The team engaged in patient rounds, MITS procedures, and service education. The collaborative initiative was entirely self-funded by local and visiting personnel. The MCTSC also consisted of 1-month observerships in Canada for 2 of Mongolia's thoracic surgeons, sponsored by the Surrey Memorial Hospital Foundation. The study was exempt from local institutional review board ethics approval given the quality improvement nature of the study. The need for patient consent was waived.

Only patients who underwent minimally invasive thoracic surgery procedures during the in-person collaboration period were included in the review of patient outcomes. Cases were jointly selected by the Canadian and Mongolian thoracic surgeons in advance of the in-person collaboration period to ensure patient safety and maximize learning opportunities for the local team. Patients were carefully selected to ensure patient safety during the locally novel minimally invasive approach. All patients underwent functional status and respiratory assessment. Consecutive patient and service data was prospectively collected through the NCCM's electronic medical records. Surgical approach (MIS vs open) for all procedures performed in 2023 by the NCCM thoracic surgery service were collected. The study's primary outcome was the feasibility of developing a self-sustainable, self-governed advanced MITS program at the NCCM. Secondary outcomes included operative time, hospital length of stay, rate of conversion, blood loss, rate of postoperative complication, and 30-day mortality. Surgical complications were defined according to the Ottawa Thoracic Morbidity & Mortality System.[11] Descriptive and quantitative statistical analyses were carried out in RStudio (R Foundation for Statistical Computing). Categorical data were reported as absolute and relative frequencies. Continuous and ordinal data were reported as mean values and medians. Difference in proportions was assessed using χ^2 or Fisher exact test. The alpha significance level was set a priori at 0.05.

RESULTS

The MCTSC took place at the NCCM from 2016 to 2019 and 2022 to 2023. Thirty-four patients underwent MITS procedures during the collaboration. Median age was 51 years (range, 16-76 years), and 41.2% (14 out of 34) were men. The cohort was composed of 35.3% smokers (12 out of 34) and 17.7% (6 out of 34) had a history of significant longitudinal air pollution exposure, defined by a reliance on cola-burning for heating during winter months. A total of 91.2% (32 out of 34) of the cohort had a preoperative forced expiratory volume in 1 second >70% (Table 1). All patients who underwent minimally invasive surgery during the in-person

TABLE 1. Patient demographics for patients undergoing minimally invasive surgery during the in-person collaboration period

Characteristic	Result
Age (y)	51 (16-76)
Sex	
Female	20 (58.8)
Male	14 (41.2)
Smoker	12 (35.3)
Chronic air pollution exposure	6 (17.7)
FEV1 <70%	3 (8.8)

Values are presented as median (range) or n (%). *FEV1*, Forced expiratory volume in 1 second.

collaboration period had an American Association of Anesthesiologists (ASA) scoroe of I-II. Only one patient had a comorbid condition (Type 2 Diabetes). Lung, esophageal, mediastinal, and chest wall procedures composed 50% (17 out of 34), 20.6% (7 out of 34), 20.6% (7 out of 34), and 8.8% (3 out of 34) of procedures, respectively. Conversion rate was 0% and median blood loss was 50 mL (range, 0-400 mL). Median operative time and hospital length of stay were 172.5 minutes and 8 days, respectively. The complication rate was 8.8% (3 out of 34) with 1 being Clavien-Dindo >3 requiring reoperation for persistent air leak, which consisted of a VATS wedge resection, after which they had an otherwise uncomplicated hospital course. Thirty-day mortality was 0% (Table 2).

Mongolia's thoracic surgeons progressed from surgical assists over the first 2 years to primary operators during the proceeding period and gained independence in advanced MITS, including in patient selection, intraoperative troubleshooting, and perioperative care (Figure 1). During the independent practice of the NCCM's thoracic surgery service in 2023, 72% (50 out of 69) of esophagectomies and 91% (48 out of 53) of lung resections were conducted via minimally invasive technique compared with 0% in 2015.

TABLE 2. Procedures and patient outcomes during in-person collaboration

Minimally invasive procedures (N = 34)	Result
Pulmonary resection	17 (50)
Left-sided lobectomy	2 (5.9)
Left-sided wedge resection	3 (8.8)
Right-sided lobectomy	7 (20.6)
Right-sided wedge resection	5 (14.7)
Esophageal surgery	7 (20.6)
Esophagectomy	4 (11.8)
Duplication cyst resection	2 (5.9)
Heller myotomy	1 (2.9)
Mediastinal mass resection	7 (20.6)
Thymectomy	1 (2.9)
Other	6 (17.7)
Chest wall mass resection	3 (8.8)
Peripheral nerve sheath tumor	1 (2.9)
Chondroma	1 (2.9)
Benign cyst	1 (2.9)
Operative time (min)	172.5 (60-576)
Wedge resection	112.5 (60-165)
Lobectomy	273 (110-495)
Esophagectomy	517 (466-576)
Blood loss (mL)	50 (0-400)
Wedge resection	60 (0-100)
Lobectomy	50 (0-400)
Esophagectomy	150 (100-200)
Hospital length of stay (d)	8 (4-20)
Wedge resection	7.5 (6-12)
Lobectomy	10 (7-20)
Esophagectomy	9.5 (8-17)
Conversion to open	0
Complications	3 (8.8)
Clavien-Dindo >3	1 (2.9)
30-d mortality	0

Values are presented are n (%) or median (range).

DISCUSSION

We herein describe the first successful establishment of a sustainable surgical ecosystem for advanced MITS in Mongolia, and the first in its region. The partnership's success and the subsequent international pollination of thoracoscopic technique is owed to the systematic approach of multidisciplinary program development. A rigorous virtual needs assessment served as the partnership's foundational framework before first in-person collaboration in 2016, assessing the requisites of the local health care landscape, local resources, skillset, and case volume. Collaborative assessment confirmed that the NCCM was well equipped in its infrastructure and human resources to provide advanced MITS. Recognizing the paramount importance of health literacy, an emphasis was placed on assessing the comprehension levels among patients and nonsurgeon providers to garner informed buy-in for these collaborative efforts.

Over the first 2 years (2016-2017), an integrated approach to the first phase of the collaboration fostered knowledge exchange by positioning the Canadian team as primary operators and in leading minimally invasive procedures. This deliberate structure aimed to facilitate a gradual sharing of operative principles and insights. The multidisciplinary team worked closely with NCCM allied health care to facilitate a locally relevant and culturally appropriate postoperative care plan. A primary focus of

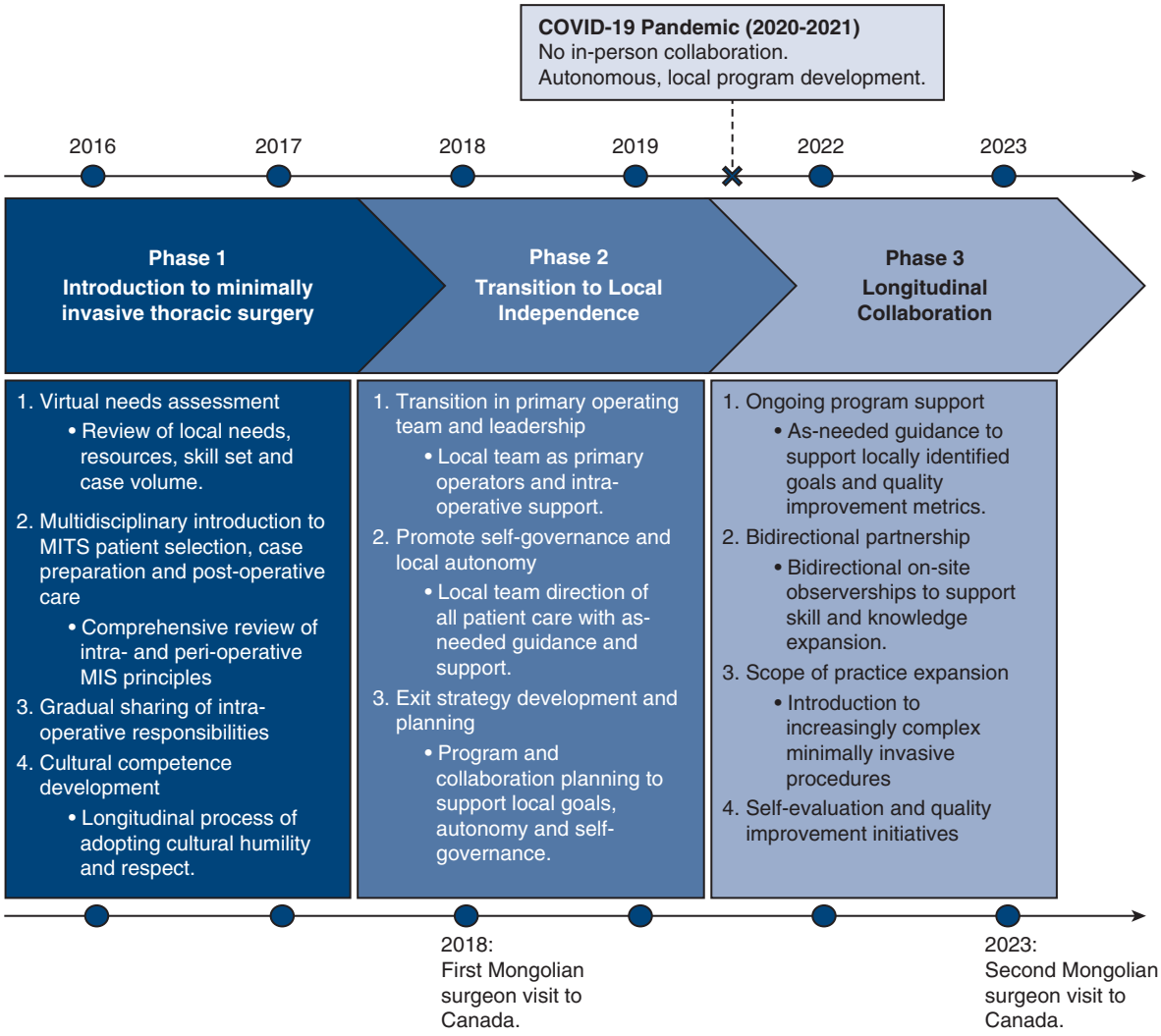

FIGURE 1. Longitudinal Mongolian-Canadian Thoracic Surgery Collaboration timeline and objectives.

this initial introductory phase was on the leveraging and utilization of local resources to achieve local goals. Access to previously acquired local minimally invasive equipment, including cameras, towers, screens, lighting equipment, and basic minimally invasive tools allowed the team to capitalize on available resources and promote sustainability. The initial needs assessment identified a lack of disposables, including thoracoscopic staplers and cartridges, which were brought by the Canadian team and acquired through donations from the Surrey Memorial Hospital Foundation and industry partners. Mongolia's first VATS lobectomy was performed in 2016 through the MCTSC.

Over the following 2 years (2018-2019), the collaboration strategically prioritized the development of technical proficiency and accelerated learning through shared primary operator responsibilities. The objective was to expedite mastery of complex thoracic surgical procedures through a progressive increase in responsibilities and governance. This second phase also prioritized planning an exit strategy that would support local goals and self-sustainability through the development of self-evaluation strategies and identifying quality improvement metrics. Although the COVID-19 pandemic halted in-person collaborative efforts from 2020 to 2021, it allowed the NCCM surgeons to continue enhancing their skills through independent conduct, leveraging the adopted principles from 2016 onward. During the last, and ongoing, phase of the partnership (2022-2023), the NCCM surgeons assumed primary intra- and perioperative roles while the Canadian team shifted to solely supportive positions. This phase facilitated a gradual withdrawal of direct guidance, enabling the NCCM team to independently navigate the complexities of advanced MITS, affirming the enduring influence of the MCTSC on the autonomy and sustainability of Mongolia's newly found MITS program. A similar, goal-directed approach of transfer of responsibilities was taken by the

visiting anesthesiologists, operating room nurses, a nurse practitioner, and a physiotherapist, ensuring appropriate perioperative care and enhanced recovery pathways. Mongolia's first minimally invasive esophagectomy was performed in 2022. The dedicated and respectful nature of the involved teams allowed for a gradual egalitarian form of knowledge exchange. The noncolonialist nature of transition in responsibility, accountability, and governance ultimately nurtured a multidisciplinary and sustainable autonomy. The equally valuable transfer of knowledge among the collaborating anesthesiologists cannot be underscored. The president of the Mongolian Society of Anesthesiologists highlighted several key areas of expetise gained through this collaboration, including multimodal analgesia techniques, strategies for double lumen intubation and troubleshooting, and one-lung ventilation experise. Additionally, novel analgesia strategies such as ultrasound-guided erector spinae and intercostal blocks were introduced.

We attribute the success of developing a self-sustainable surgical program to 3 select factors:

- Local champions

The local champions refer to individuals dedicated to the pursuit of excellence for the population they serve. The NCCM thoracic surgeons and their allied health care team demonstrated enthusiasm and devotion to improving their national thoracic surgical service. This was further demonstrated during the COVID-19 pandemic as the team independently troubleshooted locally novel challenges. A program's autonomy entirely relies on the perseverance and fidelity of its local members, as well as the willingness to evolve, demonstrated by the NCCM team.

- Optimizing available assets

Attaining funding in resource-constraint environments is a significant barrier to the globalization of surgical excellence. This collaboration was largely funded by the visiting team through donations, and the health authority of local surgeons. In 2020, a radical national shift in funding allowed for all cancer treatment to be covered by Mongolia's National Health Insurance, including all surgeries, which greatly reduced financial barriers and aided the ongoing sustainability of the program. Nonetheless, early phases of knowledge exchange (2016-2020) focused on maximizing available resources and equipment, which translated to a cost-sensitive practice, further fortifying program sustainability.

- Sustained guidance and empowerment

The longitudinal MCTSC allowed for a gradual egalitarian form of knowledge exchange. The noncolonialist nature of transition in responsibility, accountability, and self-governance nurtured multidisciplinary autonomy throughout the NCCM thoracic surgery service. The NCCM success story in part is due to the early development of an exit strategy that supports local goals. This includes the provision of tools for ongoing self-evaluation through the identification of quality metrics and methods to accurately quantify, analyze, and improve on said metrics.

Our study demonstrated a 0% 30-day mortality among the cohort of patients undergoing MITS procedures throughout the collaboration, and a 0% conversion rate. This success is likely reflective of the well selected cases, although the local team's technical proficiency cannot be discounted. In reviewing our complications rate of 9% and median hospital length of stay of 8 days, future MCTSC priorities include improving perioperative care and ultimately the establishment of a formal thoracic surgery residency program, which will aid in standardizing and optimizing patient care. Local culture greatly contributes to length of stay, and therefore, does not allow for accurate comparisons to other regions. During the MCTSC, the Canadian team observed patients being kept in hospital for longer periods to allow for in-hospital rehabilitation given their remote residence and physically demanding occupation. This was not uncommon because >25% of the Mongolian population reside in remote regions with limited accessible emergency care, and 26.4% of all households live off breeding livestock.[12] The MCTSC was not conducted without its list of challenges. These were largely mitigated in the early phases of international collaboration through emphasis on communication and cultural competence.

Global surgery partnerships, such as ours, have influences that transcend the immediately apparent patient outcomes. International collaborations serve as catalysts for global health equity, addressing disparities and advocating for comprehensive health care access worldwide. They operate as a form of humanitarian surgical diplomacy, fostering understanding and exchange across diverse health care landscapes through patient-centric innovation. Global surgery within the field of thoracic surgery remains in its adolescence, with few existing partnerships. Toronto's Addis Ababa Academic Collaboration was initiated at a similar time to the MCTSC in 2016, and recently demonstrated a similar success of enabling local minimally invasive thoracoscopic capacity.[13]

Thoracic surgical pathologies represent a significant global health concern, particularly in low- and middle-income countries. The WHO identifies trachea, bronchus, and lung cancer as the sixth leading cause of overall mortality worldwide,[14] highlighting the crucial need to enhance accessibility to global thoracic surgical care. Global initiatives following the Lancet Commission call to action have sought to analyze existing surgical workforce and cultivate strategies to progress it further among low- and middle-income countries.[15] Despite substantial progress, the shortage of thoracic surgery providers remains severe.[16-18] The 2020-2021 WHO global survey on the inclusion of cancer care

in health-benefit packages demonstrated that the inclusion of lung cancer care has the widest disparity among low- and high-income countries.[18] Breast and cervical cancer surgeries are covered at a 3-fold rate compared with lung-cancer surgeries.[19] The successful development of Mongolia's advanced MITS program aims to mitigate these global inequities and is 1 of few existing intercontinental thoracic surgery knowledge exchange collaborations. Such programs are well positioned to serve as a source of guidance and inspiration for future global thoracic surgery initiatives.

Our study is not without limitations. We solely reported on patients who underwent MITS during in-person collaboration, rather than all patients treated at the NCCM during the study period. The early inception of a comprehensive database was hindered by limitations in research-focused personnel and funding outside the in-person collaboration period. This restricted the inclusion and reporting of all NCCM thoracic surgery patients. Future partnership efforts will focus on developing a database through which quality indicators can be collected and followed. Additionally, the sample size for each case type was small and does not allow for parametric, in-depth analysis of outcomes.

CONCLUSIONS

We demonstrate the first successful implementation of an advanced MITS program in Mongolia (Figure 2). The Mongolian-Canadian collaboration has demonstrated successful transfer of MITS proficiency through global surgical partnership, consequentially shifting the national thoracic surgical paradigm. The MCTSC allowed for Mongolian autonomy with acceptable postoperative complication and 30-day mortality rates. Success was attributable to a noncolonialist, egalitarian training model implemented with emphasis on capacity strengthening, self-governance, and sustainability. Continued collaboration will focus on sustainability and supporting local surgeons in regional dissemination of MITS proficiency through a local resident training program with the aim of elevating global thoracic surgical standards. We believe the domino effect of surgical education will continue to propagate as Mongolia becomes the region's hub of MITS and additional academic partnerships are formed. Further program review is needed to identify learning curves and demonstrate noninferiority in long-term outcomes for MITS versus open approach.

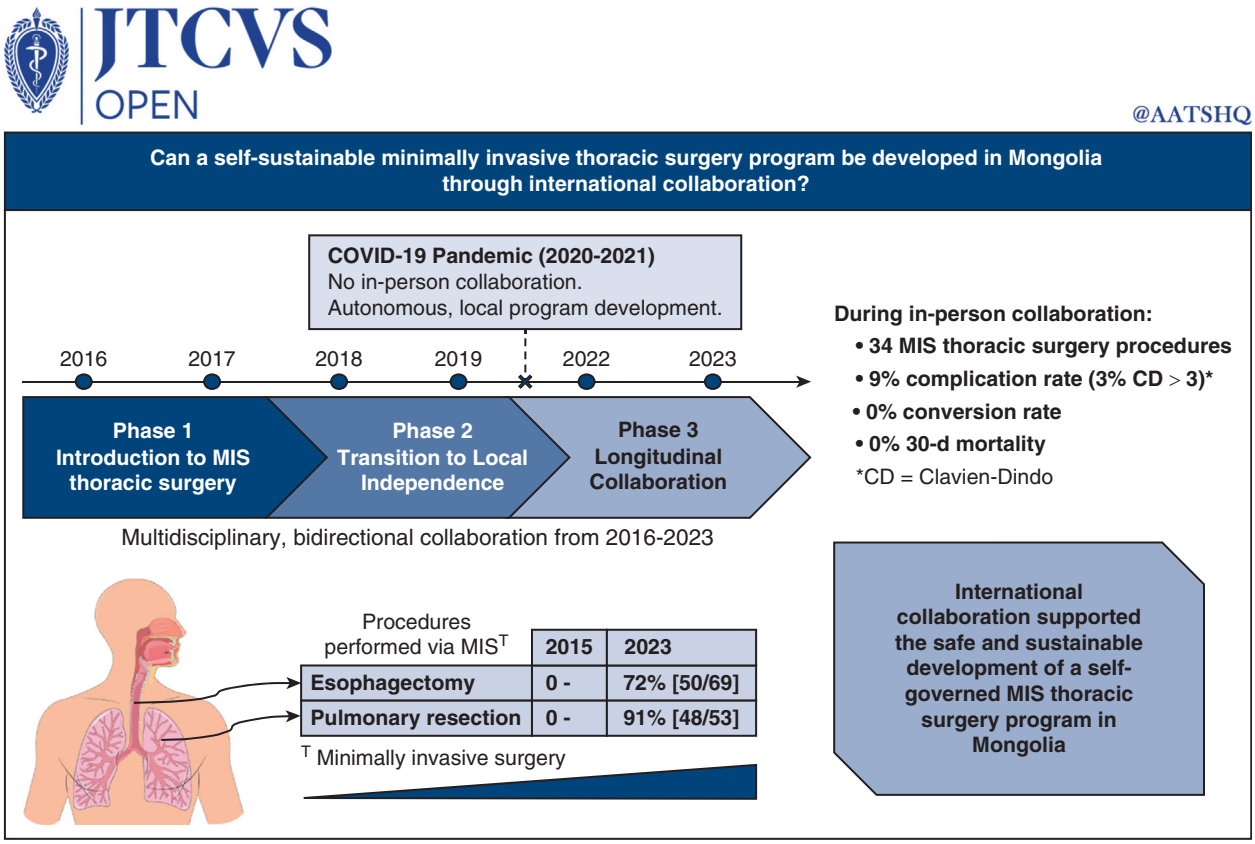

FIGURE 2. Graphical abstract.

Webcast

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Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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