



International cooperation group of emergency surgery during the COVID-19 pandemic

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Abstract

Purpose The COVID-19 pandemic has changed working conditions for emergency surgical teams around the world. International surgical societies have issued clinical recommendations to optimize surgical management. This international study aimed to assess the degree of emergency surgical teams' adoption of recommendations during the pandemic.

Methods Emergency surgical team members from over 30 countries were invited to answer an anonymous, prospective, online survey to assess team organization, PPE-related aspects, OR preparations, anesthesiologic considerations, and surgical management for emergency surgery during the pandemic.

Results One-hundred-and-thirty-four questionnaires were returned ($N = 134$) from 26 countries, of which 88% were surgeons, 7% surgical trainees, 4% anesthesiologists. 81% of the respondents got involved with COVID-19 crisis management. Social media were used by 91% of the respondents to access the recommendations, and 66% used videoconference tools for team communication. 51% had not received PPE training before the pandemic, 73% reported equipment shortage, and 55% informed about re-use of N95/FPP2/3 respirators. Dedicated COVID operating areas were cited by 77% of the respondents, 44% had performed emergency surgical procedures on COVID-19 patients, and over half (52%), favored performing laparoscopic over open surgical procedures.

Conclusion Surgical team members have responded with leadership to the COVID-19 pandemic, with crisis management principles. Social media and videoconference have been used by the vast majority to access guidelines or to communicate during social distancing. The level of adoption of current recommendations is high for organizational aspects and surgical management, but not so for PPE training and availability, and anesthesiologic considerations.

Keywords Coronavirus infections · Pandemic · Personal protective equipment · Surgery · Patient care team

Abbreviations

COA	COVID operating areas
ICU	Intensive Care Unit
OR	Operating room
OTI	Orotracheal intubation
PPE	Personal protective equipment
Po/PACU	Preoperative–Postoperative Anesthesia Care Unit
RSI	Rapid sequence induction
RT-PCR	Reverse transcriptase-polymerase chain reaction

SARS-CoV-2	Severe Respiratory Syndrome Coronavirus 2
WHO	World Health Organization

Introduction

In December of 2019, the world learned about the emergence of a new coronavirus outbreak, this time in Wuhan, Hubei province, China. Initially termed 2019 novel coronavirus (2019-nCoV), it would be known worldwide as the Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2) [1]. This new disease was termed as COVID-19 and spread rapidly worldwide. On March 11, 2020, the World Health Organization (WHO) declared the disease caused by the SARS-CoV-2 a worldwide pandemic [2]. The high

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transmissibility of the SARS-CoV-2 and the overwhelming magnitude of this pandemic forced surgery teams to re-examine workflow, organization, and management for surgical emergency cases [3]. These unprecedented challenges imposed swift changes to avoid the collapse of the health system and the workforce's compromise [4]. To prepare surgical teams for this infectious mass casualty scenario, several international surgical and anesthesia societies produced guidelines on emergency surgery, focusing on preventing the infection of its workforce and guarantee the best response [5–13]. These COVID-19 dedicated protocols addressed surgical team organization, operating room (OR) preparation, rational use of personal protective equipment (PPE), considerations on anesthesiology, and intraoperative management of emergency surgical pathology. Several articles have been published focusing on the technical surgical aspects during the pandemic and surgical ward preparations [14–17]. However, fewer have put the spotlight on individual countries' responses [18], and none that we know have assessed the level of adoptions of current recommendations at an international level. This study aimed to obtain a global snapshot of the level of implementation of these new recommendations by the members of the international emergency surgery community during the COVID-19 pandemic.

Methods

An International Cooperation Group of Emergency Surgery during the COVID-19 pandemic was formed with surgeons from Brazil, Chile, Italy, Portugal, and Spain to study the pandemic's impact on emergency surgery teams at the international level. The group used the SurveyMonkey® platform to develop a five-section structured questionnaire in English that assessed the adoption of updated recommendations for emergency surgery during the COVID-19 pandemic. No specific identifying data were requested, six questions queried about demographic information, seven about team organization, 25 regarding PPE, 21 OR adequation, anesthesia considerations, and surgical management.

The questions were presented in such a way that respondents could agree or disagree with the specific statements. The online survey was issued prospectively, anonymously and voluntarily, from the 1st to the 14th of April 2020, to 680 members of emergency surgical teams from over 30 countries. The survey target population was selected using a non-probability method consisting of a convenience sample of five significant surgeons' associations, which included professionals ascribed to the Spanish Surgical Association, European Society for Emergency and Trauma Surgery, International Association for Trauma Surgery and Intensive Care, American College of Surgeons, and the Panamerican Trauma Society. Subjects were invited through email

invitations, mailing lists of some participating societies, and posted via personal networks and social media. Survey results were analyzed using the SurveyMonkey® online platform (SVMK Inc, San Mateo, USA), calculating frequencies and percentages of the collected data.

Results

A total of 134 valid responses from 26 countries were obtained from 680 (20%) of the issued invitations, of which 119 (88%) were surgeons, 9 (7%) surgical trainees, and 6 (4%) anesthetists. The vast majority were males (72%), with ages ranging from 25 to over 60. Respondents worked in 26 different countries, mostly from Europe, with 85 responses from 8 different countries, followed by 42 responses from 12 American countries, five from four countries in the Middle East, and two countries from Asia, with one response each Fig. 1.

Surgical team organization

81% of the respondents got involved with the COVID-19 surge planning taskforce, 93 (71%) developing clinical protocols, 91 (69%) implementing safety precautions, and 67 (51%) performing task management. Social media and other online resources were employed by 122 (91%) respondents to obtain relevant COVID-19 clinical guidelines Fig. 2. Modification of shift handover routines and the use of video conference tools, to maintain communication



Fig. 1 Respondents ($N=134$) by region and country



Fig. 2 Participants' use of social media channels

while promoting social distancing within the working place, was reported by 88 (66%) of them Fig. 3. Continuity performing their regular tasks was reported by 73 (54%) of the respondents, in contrast with the rest, whose newly assigned duties were to the emergency department COVID-19 triage (25%), the intensive care unit (ICU) activities (13%), or had to manage mechanically ventilated patients in the surgical ward (7%). Another modification to their routines was in shift duration, as reported by 80 (60%), and over half of the total (52%) worked continuously for extended periods of 24 h or more.

Personal protective equipment (PPE)

About half (51%) of the respondents had not received training in the use of PPE for airborne infectious risk while performing emergency surgical procedures before the pandemic, and roughly over one-third (37%) had it during the studied period. Of all the respondents, 105 (78%) used surgical masks, and 38 (28%) wore N95/FPP2/3 respirators always in the ward, even without COVID-19 hospitalized. Over half (56%) had a specific area assigned for donning/doffing the PPE, 53% employed checklist, and 60% performed routine buddy checks. Three-fourths (75%) made mask fit tests while donning, one-third (34%) reported that fitting issues due to facial hair (beard), and out of these,

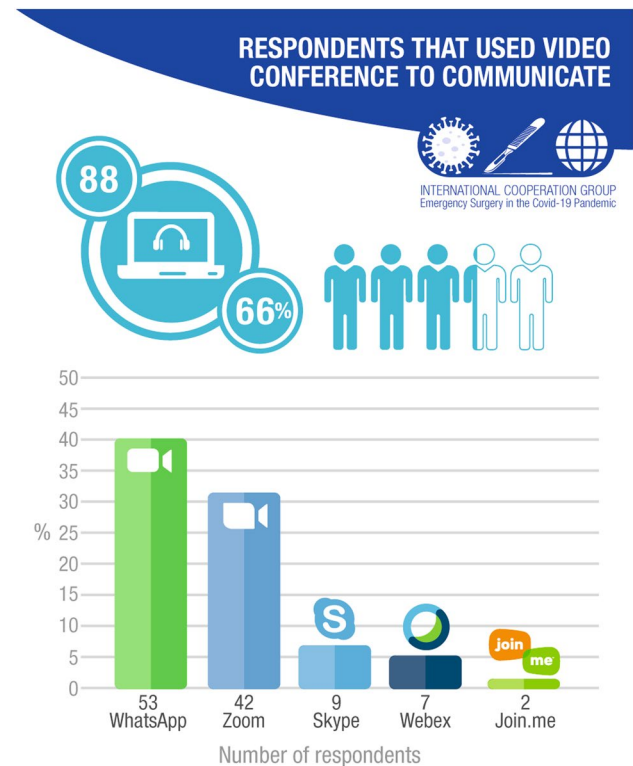


Fig. 3 Participants' use of video conference tools

half (51%) shaved it to obtain an adequate fit. The reported PPE used for emergency procedures was face shield (74%), double gloving (71%), surgical goggles (68%), long sleeve disposable gown (63%), and water-resistant shoe covers (35%) Fig. 4. Data about the shortage of PPE (73%) and N95/FPP2/3 (77%), as well as the re-use of PPE components (55%), were collected Fig. 5. Reuse or extended use of N95/FPP2/3 beyond the lapse they were designed for was commented by 55% of the respondents Fig. 5. Scarcity or even absence of parts of such equipment was reported by 53% Fig. 6.

When asked if using PPE gave a sense of protection during the surgical procedure, less than half (48%) of the respondents felt protected with PPE.

Operating room preparations

Over three-fourths (77%) of the participants had COVID operating areas (COA), OR facilities prepared or modified for performing emergency surgery in COVID-19 patients, and over two-thirds (69%) had a designated COVID-19 trauma OR. The vast majority (80%) cleared out unnecessary equipment from the OR when performing surgery on COVID-19 patients, and 78 (60%) protected monitors and other electronic equipment, including anesthesia machine, with plastic wraps; 70% used OR alert signs during the

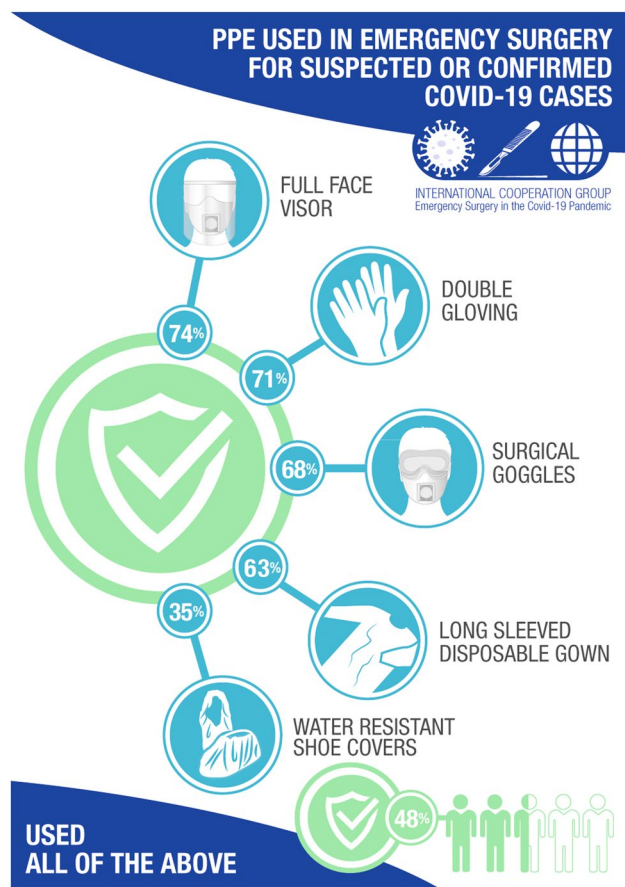


Fig. 4 Personal protective equipment used for emergency surgery

procedure in COVID-19-positive or suspected cases. However, only over one-fourth (26%) had surgical smoke evacuation systems available, and above two-fifths (43%) had to improvise such a device.

Anesthesiologic equipment considerations

When asked about the transport of emergency surgical cases to the OR, almost two-thirds (64%) answered that COVID-19 emergency surgical cases were escorted directly to the OR, not stopping in the Preoperative–Postoperative Anesthesia Care Unit (Po/PACU). Regarding anesthesiologic equipment preparations, less than half (40%) had a COVID-19 resource box available for general anesthesia procedures (including cheat sheets and alert signs). Only one-fourth (25%) said to have a specific COVID-19 airway trolley at their institution, and of these, 27% had access to a printed intubation guideline. Over one-third (38%) responded that the anesthesia team routinely used video laryngoscopy for orotracheal intubation (OTI), and almost two-thirds did not know if rapid sequence induction (RSI) was the induction protocol used.

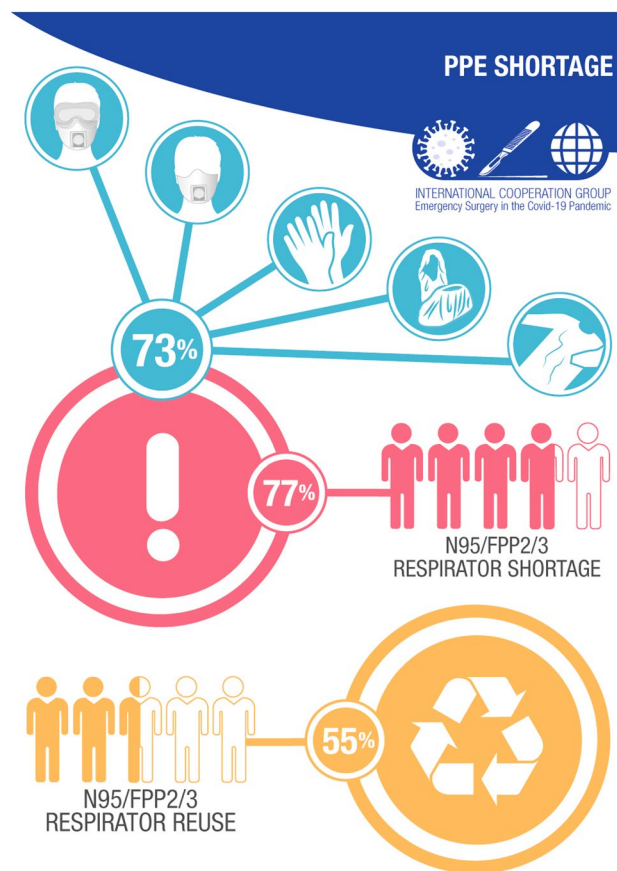


Fig. 5 Shortage of Personal protective equipment for emergency surgical procedures

Emergency intraoperative management

Almost two-thirds used a COVID-19-specific checklist before surgery, and an equal number of respondents entered the OR after patient intubation. Less than half (44%) had performed emergency surgical procedures on COVID-19 patients during the study, and only over one-fourth, 26% had performed emergency laparoscopic surgery on these patients. However, when asked which approach was preferred for acute appendicitis or cholecystitis, over half (52%), preferred the laparoscopic approach. When asked for preoperative screening methods, only one-third (32%) systematically performed COVID-19 screening before emergency surgery. 50% of these used the reverse transcriptase-polymerase chain reaction (RT-PCR) test, the rest resorted to radiological screening, either thoracic CT scans (14%) or lung US (1%). When asked for the number of emergency cases evaluated in the emergency department, the vast majority (82%) perceived a lower frequency of emergency surgical emergencies during the studied period.

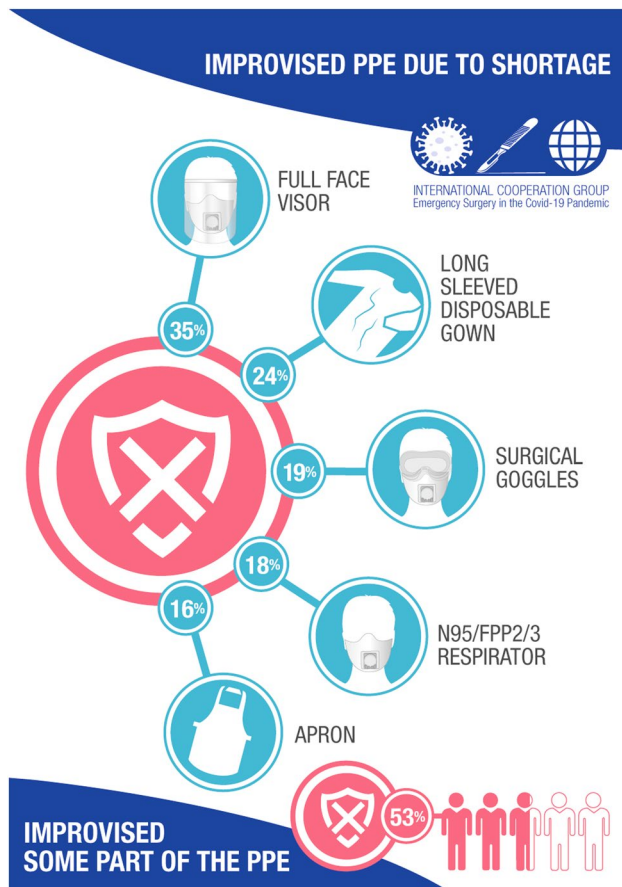


Fig. 6 Improvisation of personal protective equipment in emergency surgery

Discussion

While the novelty of this pandemic has generated many published papers on management recommendations [19–23], few assess the degree of guidelines implementation by emergency surgical teams. This study provides an international snapshot of the level of adoption of the guidance for surgical team organization, adequacy of PPE availability and usage, OR preparation, anesthesiologic considerations, and intra-operative management of emergency surgical cases during 2 weeks of the COVID-19 pandemic. It should be noted that the study tried to capture the initial response when there was a steep curve of newly reported cases, but while that was the case in Europe at the time of the survey, the American surge came weeks later. The study analyzed the recommendations for emergency surgical management of COVID-19 suspected or confirmed cases, which may differ significantly between countries due to the variability of the number of newly diagnosed cases, resources available, and healthcare policies. Increased awareness and adoption of international societies' recommendations for emergency surgical management with greater exposure to COVID-19 were expected

amongst surgeons with higher case exposure, but the study design did not allow this assumption. Nonetheless, the study can help identify weaknesses in the surgical team response and areas of improvement, which could be useful to face the latest news that brings up attention like the possibility of a second wave of the pandemic [24–26].

Regarding the surgical teams' organization, most of the published literature focuses on reducing the risk of infection by limiting the number of workforce members on each procedure [2, 27]. Furthermore, the emphasis is made on rescheduling elective surgical procedures to rationalize hospital bed capacity. However, few mention surgical teams' leadership organizing the response to the pandemic [28]. We found out that over 80% of the teams' members have been doing so, either developing protocols (71%) and implementing safety precautions (69%), which confirms the capacity of emergency surgical to rapidly adapt to complex crises, organizing proactive medical responses when facing natural or human-made disasters [29].

The 2009 H1N1 pandemic revealed that communication dynamics are vital for crisis management, and the use of practical tools for the transmission of health recommendations increases compliance [30]. Social media and online resources are now used by more than 3.8 billion, Twitter, and other social media channels can be a reliable source of health-related information [31]. The COVID-19 pandemic has demonstrated that emergency surgical teams and health-care bodies could use online tools to disseminate guidelines and maintain communication in times of uncertainty [32]. Our study reveals the use of these tools by 91% of the respondents and the utilization of video conferences by 66% to improve communication between team members during social distancing. They also had to adapt to new roles when they were assigned to the emergency department triage, ICU, or the management of mechanically ventilated patients, 60% had to endure long working shifts, and 52% had 24 h or more in extremely stressful situations.

Focusing on PPE, current literature reports that there are four essential elements regarding PPE: training, availability, adequate use, and re-use strategies in case of shortage [33–36]. Our study reflects that following PPE recommendations had been a significant issue among respondents; over half expressed concerns for insufficient training, 71% have reported shortages, and 53% improvised part of their protective equipment. Training of proper donning/doffing techniques is essential, it will lower the probability of self-contamination, and educational campaigns must emphasize biosafety breaches to reduce surgical team members' exposure to it [37–40]. A critical shortage of N95/FPP2/3 respirators was reported. This can be explained by the underestimation of equipment needs, coupled with the abrupt increase of its global demand. A recent survey about PPE supplies in the US reported that 91% of the 213 queried cities had

inadequate face mask supplies, and 88% did not have enough PPE for medical personnel and first responders [41]. Tabah et al. in a recent international survey among 2711 intensive care unit healthcare workers, reported widespread shortage and adverse re-use [42]. Another aspect that stands out in our study is that over half (53%) of the population had to improvise PPE, undermining front-line workers' trust and confidence with their employer institutions [43]. Additionally, equipment shortage, re-use, and improvisation elevate the risk of infection, adding to the sense of hazardous exposure, and increasing work-associated stress.

Concerning the operating conditions, 71% had prepared COA and most followed guidelines to adapt the existing conditions to the suggested recommendations [3]. Information regarding negative pressure OR suites was not addressed in the survey, but if available, negative pressure ORs should be used to reduce the risk of viral spread and minimize infection risk [44]. One element that should be pointed out is the management of surgical smoke during the pandemic. At the beginning of the COVID-19 outbreak, many guidelines recommended avoiding laparoscopy due to the possibility of viral aerosolization and team infection due to smoke inhalation. Current publications have downsized these risks with measures of smoke/aerosol containment and proper smoke evacuation. However, only 26% reported to have purposed design smoke evacuation systems, and almost half had to improvise them using standard filters, and waters seal devices [45], which could be useful for smoke and vapors generated electrosurgical and ultrasonic devices until more evidence-based research in this field is available.

Reported results of anesthesiologic protocol adoption by the emergency surgery teams reflect a significant lack of implementation of the official recommendations promoted by international anesthesia societies [46, 47]. Our results suggest that improvements must be addressed, especially with equipment preparation during airway manipulation. The importance of having prepared an individual COVID-19 airway trolley with printed airway guidelines should not be underestimated. We consider these elements essential since the use of PPE in the OR has been associated with communication interference and visibility impairment [47]. Using a specific trolley with printed instructions would help avoid errors and reduce team members' risks. Because of the limited number of questions in this area and the reduced number of anesthesiologists participating in our study, we consider our finding as limited and that further analysis is needed.

Answers received about the operative management reflect the existing differences in the number of new COVID-19-positive registered cases in the participating countries during the studied period. During April 2020, the number of new cases was counted by the thousands in several European countries, with Spain and Italy among them, while in America, it was only starting to be diagnosed. Despite these

differences, 44% of the respondents had performed emergency surgery on COVID-19-positive patients. It is essential to highlight the need to use aerosol-generating procedures (AGP) checklists in all emergency surgical procedures. Soma et al. describe how an operative team checklist can potentially reduce risks, but above all, it reduces anxiety and helps maintain the team focused on the task [48]. Results reflect the concerns with the laparoscopic approach and the risks of viral aerosolization. In our study, only 26% had performed laparoscopic procedures [49]. The low level of reported preoperative COVID-19 screening (32%) is of serious concern, and efforts should be made to perform some screening for all emergency surgical cases.

Our study had some limitations that must be noted. First, the 2-week period studied reflected a global snapshot of the pandemic, and the number of newly reported cases between Asia, Europe, and America has not been homogeneous. Second, the level of the reported adoptions of the continually changing recommendations reflects respondents' perceptions and opinions, which may not accurately represent actual practices. Confirmation of the reported findings should be audited in future studies. This is particularly important with PPE since the massive demand worldwide had generated a global shortage of some equipment. Also, the survey design might have introduced some bias and had a relatively small sample size. Only 20% of the contacted participants; this is especially important regarding the small number of anesthesiologists included in the study ($n=6$). Finally, our sampling strategy recruited mostly European and American respondents, with very few emergency surgeons from Asia and the Middle East, so that results may be biased. Despite these limitations, the findings reflect the leadership and level of involvement of surgical teams during the pandemic. It identifies the urgent need for more training and better endowment of PPE among emergency surgical teams worldwide. The addressing of these issues will allow better preparation for future similar scenarios and guarantee a better response in case of a second wave of the pandemic to be registered in the coming months.

Conclusion

Respondents exercised leadership through the development of surgical protocols and safety measures. Social media and video conferences resulted in capital importance for accessing reliable clinical management guidelines and for team communication while maintaining social distancing. Urgent measures to assure sufficient availability of PPE shortage, particularly N95/FPP2/3 respirators must be addressed by healthcare administrators and governments. Even though operative room preparation was adequate, very few had a specific COVID-19 airway trolley at their

institution; improvements in airway management equipment are advisable.

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Author contributions All authors meet authorship criteria for this manuscript as described below. The communication was conceived by CY, AG, HA, and JLB. The literature search was performed by CY, MR, SF, MA. The manuscript draft was written by CY, MR, SDS, LP. Critical revision was done by AG, MR, HA, SF, MA, SDS, LP, AG, and CM. All authors reviewed and approved the final manuscript.

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Compliance with ethical standards

Conflict of interest Carlos Yáñez Benítez, Marcelo Ribeiro, Henrique Alexandrino, Piotr Koleda, Sérgio Faria Baptista, Mohammad Azfar, Salomone Di Saverio, Luca Ponchiotti, Antonio Güemes, Juan L Blas, and Carlos Mesquita have no conflict of interest.

Ethical standards This article does not contain any studies involving human or animal participants performed by any of the authors.






Availability of data and material The data that support the findings of this study are available from [SurveyMonkey® online platform, SVMK Inc, San Mateo, USA] but restrictions apply to the availability of these data, which were used under license for the current study during the study period, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [SurveyMonkey®].

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