



# Robotic surgery during the COVID pandemic: why now and why for the future

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## Abstract

Health care has changed in unprecedented ways since the first reported cases of COVID-19. With global case rates continuing to rise and government restrictions beginning to loosen, many worry that a second wave is in our future. In many hospitals around the world, non-emergent surgeries were put on hold as hospitals were transformed into COVID centers. As surgeons and administrators do their best to reinstate non-emergent procedures, guidance is sought from any and all reliable sources. Robotic surgery has many known and demonstrated benefits over open surgery and often over conventional laparoscopy. In this commentary, we aim to highlight some of the advantages robotic surgery may offer during this uniquely challenging time in health care.

**Keywords** COVID-19 · Minimally invasive surgery · Robotic surgery · Value

## Introduction

In the medical era of COVID-19, health-care systems must create innovative solutions to adapt and survive in the changing surgical landscape. Health-care systems are attempting to return to a semblance of pre-pandemic practice, with new case rates continuing to increase globally, state stay-at-home orders beginning to be lifted, and non-emergent surgical procedures being slowly reinstated [1]. However, circumstances have changed, and to return to what we once considered “normal” requires us to confront multiple barriers that have largely remained unaddressed.

The strict safety measures enforced during the novel coronavirus pandemic will likely remain until an effective vaccine is widely distributed—which many leading scientists predict will not occur this year. Only recently have major surgical societies released triaging algorithms for non-emergent surgical procedures [2,3]. Despite these algorithms, many hospitals have not seen the infection curve flatten

enough to where health-care systems can safely reinstitute non-emergent surgeries without strict precautions. Many hospitals around the world continue to operate as COVID centers at surge capacity with diminishing supplies of personal protective equipment (PPE).

Nonetheless, like all hardships the medical community has faced in the past, this difficult period will eventually pass. Hopefully, in the near future we will find ourselves in a post-COVID era, resuming familiar patient care. It is imperative that we reflect on lessons learned during this pandemic to appropriately position ourselves successfully for the future. If we do not prepare properly and plan carefully for the future, upcoming disruptions to the health-care systems, like a second wave of this pandemic, may have disastrous effects.

## Impact of surgical freeze

With the spread of COVID-19, many hospitals froze all non-emergent surgical procedures out of safety concerns. The American College of Surgeons (ACS) and the Centers for Disease Control and Prevention (CDC) recommended cancelling or postponing non-emergent surgeries since March 2020. This move, although necessary for societal safety, impacted millions of lives. Since this cessation, surgical waiting lists continued to grow [4]. During this waiting

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period, hospital resources were depleted at many institutions and surgical staff and equipment were repurposed.

Fortunately, the swift implementation of telehealth allowed for office visits to continue. Patients can now be evaluated, assessed, and counseled via telemedicine. This is extremely helpful because when non-emergent procedures resume, patients will have already fulfilled their pre-operative requirements.

Yet, the return to scheduling of non-emergency procedures poses other challenges. Surgeons, in addition to counseling and treating a patient, must also take other factors into consideration. We must now consider the availability of the medical staff and hospital resources, the transmission risk of COVID-19 to health-care workers and non-infected patients, and perioperative outcomes when triaging surgeries [5]. Widespread adoption of outpatient major surgical procedures should be considered whenever safe and feasible, utilizing risk predictors whenever available [6–8]. Once we have utilized ethical and effective triaging systems, we must also contemplate the surgical route for the procedure, a consideration not yet addressed in the available literature. All efforts should be made to utilize the surgical modality associated with the best patient outcomes while minimizing strain on already fragile health-care systems.

## The value of robotics in the post-COVID era

The clinical advantages of the robotic surgical system have never been more important than during and following this pandemic. In general, research suggests that robotic surgery is associated with improved clinical outcomes for patients [9,10]. With lower rates of conversion to laparotomy and decreased complication rates compared to abdominal and conventional laparoscopy, increased implementation of robotic surgery can lead to decreased hospital resource utilization [10].

Surgeons must make every effort to minimize patient time spent inside the hospital, as this will always be a possible source of transmission. Additionally, as many infected individuals are asymptomatic, minimizing exposure to health-care facilities must be paramount until there is widely available rapid COVID-19 testing available. Laparotomy is associated with increased length of hospital stay, which places patients and health-care providers at unnecessarily high risk of COVID-19 transmission [11–13]. It has been well established in the literature that minimally invasive surgery has lower cost, decreased postoperative recovery time, decreased immediate post-surgical pain and less analgesic use, decreased complications, and decreased infection rates compared to laparotomy [14–16]. But it is important to note that of the minimally invasive routes, robotic surgery has a

lower likelihood of overnight admission when compared to conventional laparoscopy [17].

Aside from the obvious benefit of low complication rates, the minimization of surgical complications will also help to keep patients outside of the health-care system and emergency rooms. Understandably, COVID-19-negative individuals are at high risk for transmission in emergency departments and thus should avoid their utilization at all costs. Evidence suggests that experienced robotic surgeons have the lowest rates of operative complications, but that even novice robotic surgery is associated with fewer complications than laparotomy [18,19]. By using a robotic surgical route, we can keep COVID-19-negative individuals away from high-risk areas. If testing is not available, then robotic surgery offers the quickest and most efficient way to perform non-emergent surgery with lowest risk to personnel and quickly allowing patients to return home.

Another risk to evaluate is the risk of transmission during surgery. It is well established that COVID-19 spreads via droplets; viral particles can also spread with aerosolization procedures [20]. With regard to surgery, there is some concern around aerosolization of viral particles in the pneumoperitoneum and surgical plume, both of which are essential parts of minimally invasive surgery. Release of pneumoperitoneum when venting, changing instruments, or removal could theoretically allow for virus transmission. When electro-surgical instruments are activated, they could release aerosolized debris into the abdomen. Referring back to previous research conducted around hepatitis B and human papillomavirus and laparoscopy, although these viruses were detected in surgical plume and in smoke evacuation systems, there was no evidence that the particles could be transmitted to the surgical team or develop into an active viral infection [20–24]. To mitigate this theoretical risk, we can use closed-circuit surgical smoke systems and reduce the amount of pneumoperitoneum during surgery. Both robotic-assisted and traditional laparoscopy limit the intraabdominal aerosolization by surgical plume when compared to laparotomy by the sheer nature of the amount of open area to the surgical team. Additionally, the limited exposure to blood during minimally invasive technique, if any, is a decreased risk of exposure to any viral infection. Overall, minimally invasive techniques have a self-contained operative field with less (and possible no) spillage of fluids and tissues, significantly reducing risk to the operative staff.

There are some key major advantages to robotic surgery over traditional laparoscopy, one being abdominal pressure. Normally, conventional laparoscopy requires 10–15 mmHg of abdominal pressure. Robotic surgery can be safely performed with pressures less than 10 mmHg [25]. This lower requirement of pressure likely reduces the risk of transmission of viral particles to the health-care team. Another advantage is the number of personnel in a robotic

operating room and the distance between the team members. In conventional laparoscopy, traditionally the surgical team includes the surgeon, one assistant, a scrub technician, and a circulating nurse. These members are in close proximity to each other. With a robotic case, the surgeon console is separate from the robotic cart, providing more space between team members. Additionally, with reduced port, robotic surgery major procedures can require less assistants, meaning less overall exposure.

An often overlooked final dilemma hospitals and surgeons will likely encounter as non-emergent surgical procedures resume will be the impact of both the COVID pandemic and the global economic recession on health care. As businesses closed out of safety precautions for employees, it remains unknown what impact this will have on the availability of surgical instrumentation and operating room ancillary equipment. However, suppliers of the robotic surgical console take pride in seeking out parts suppliers best suited to thrive during certain hardships. Robotic equipment trays are also being streamlined in many institutions to reduce waste, optimize equipment availability, and optimize operating room efficiency.

## Conclusion

As we start to transition back to performing non-emergent surgeries, many protocols and safety measures must be in place for the safety of our patients and health-care teams. There are strategies to mitigate these risks, but most importantly the route by which we conduct surgery is particularly important. Robotic surgery plays an important role in the ability to continue providing excellent surgical care for women throughout the world. Robotic surgery decreases the length of stay for patients, thereby increasing the availability of beds for other hospital needs. The self-contained operative field, with smoke evacuation and low pneumoperitoneum pressures, minimizing use of energy devices, decreases the risk of potential viral transmission to the health-care staff. Additionally, robotic surgery allows for the staff and surgeon to be remote from the patient and from each other. These advantages of robotics, combined with the use of appropriate PPE, will allow us to provide safe and the much needed surgical management of our patients.

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## Compliance with ethical standards

**Conflict of interest** Dr. Moawad is a speaker for Intuitive Surgical. Dr. Martino is a patient safety consultant for Intuitive Surgical, Medtronic, Ethicon and CMR.

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