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COVID-19 in the Surgical Department: A Comprehensive Assessment of Patient Outcomes Stratified by Infection Timing and Surgery Urgency (2023–2026)

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Abstract

The COVID-19 pandemic fundamentally disrupted surgical care worldwide. While early pandemic data established a dramatically elevated perioperative mortality burden, the clinical landscape has evolved substantially through vaccination, viral attenuation with the Omicron variant, and acquired immunity. This review synthesizes evidence published between 2023 and 2026, focusing on patient outcomes in surgical departments stratified by the timing of SARS-CoV-2 infection — active (≤14 days), recent (15–42 days), and prior (>42 days) — and comparing elective versus emergency surgical contexts. Key findings demonstrate a time-dependent risk gradient: active perioperative infection confers an adjusted odds ratio of 2.67 for postoperative complications within one week pre-operatively, a risk that normalizes beyond 14–21 days in vaccinated, low-comorbidity patients. Emergency surgery with concurrent COVID-19 carries a 12.3-fold increased 30-day mortality compared to matched controls. Long COVID introduces an under-characterized but clinically significant perioperative challenge, particularly affecting respiratory and neurocognitive domains. Updated international guidelines now support surgery as early as 2–3 weeks post-infection for most patients, marking a paradigm shift from the earlier 7-week recommendation. Stratified risk assessment incorporating infection timing, disease severity, vaccination status, ASA classification, and surgery urgency is essential for safe perioperative decision-making in the COVID-19 endemic era.

Keywords: *COVID-19, perioperative outcomes, surgical mortality, infection timing, elective surgery, emergency surgery, long COVID, SARS-CoV-2, postoperative complications, vaccination*

Introduction

SARS-CoV-2, first identified in December 2019, triggered a global health emergency that cascaded through every domain of healthcare, none more acutely than surgical services. By 2020, the landmark COVIDSurg Collaborative study across 235 hospitals in 24 countries documented a 30-day postoperative mortality of 23.8% and pulmonary complications in 51.2% of patients with perioperative infection, establishing the severity of the perioperative risk landscape from the pandemic's earliest phase. A subsequent meta-analysis of 46 studies encompassing 80,015 patients confirmed a nine-fold increased mortality risk in surgical patients with COVID-19 compared to those without, with the mortality risk nearly double in low- and middle-income countries.[1][2][3]

The scale of disruption was enormous. Approximately 28 million elective surgeries were cancelled globally during the first 12 weeks of peak pandemic disruption, and surgical oncology, cardiac, urologic, orthopedic, and general surgery subspecialties experienced the most sustained volume declines, with inadequate recovery through 2021. In England and Wales alone, an additional 2.3 million surgeries were estimated to have accumulated on waiting lists beyond pre-pandemic backlogs.[4][5]

However, the epidemiological and immunological context has transformed significantly by 2023–2026. The Omicron variant, widespread vaccination, and hybrid immunity have attenuated disease severity and case fatality rates. A pivotal multi-centre study of 140,231 patients across 116 countries previously established that delaying elective surgery by at least 7 weeks after SARS-CoV-2 diagnosis

significantly reduced 30-day mortality and pulmonary complications. These early recommendations, formulated in a pre-vaccine, alpha-delta variant era, have been progressively challenged by contemporary evidence supporting shorter perioperative intervals for appropriately risk-stratified patients.[6][7][8][9]

Three specific evidence gaps have emerged as clinically critical: (1) the optimal surgical timing relative to COVID-19 infection in the Omicron/post-Omicron era; (2) the differential impact on elective versus emergency surgical populations; and (3) the implications of long COVID or post-acute sequelae of SARS-CoV-2 infection (PASC) on perioperative safety. This review addresses all three domains using evidence from the 2023–2026 literature.

Methods

A structured literature search was conducted across PubMed/MEDLINE, Scopus, PMC, and preprint repositories (medRxiv) for studies published between January 2023 and April 2026. Search terms included combinations of: "COVID-19," "SARS-CoV-2," "surgery," "perioperative," "surgical outcomes," "mortality," "postoperative complications," "elective surgery," "emergency surgery," "timing of surgery," "long COVID," "vaccination," and "perioperative risk." Studies were included if they reported original data or systematic analyses of surgical outcomes in patients with confirmed or prior SARS-CoV-2 infection, published within the target time frame. Studies limited to ICU patients without a surgical comparator, case reports with fewer than 10 patients, and non-peer-reviewed commentaries were excluded. The review was conducted following PRISMA narrative synthesis guidance.

Infection Timing Categories

For analytical clarity, perioperative COVID-19 infection was stratified into three temporal categories:

Category	Definition	Rationale
Active	SARS-CoV-2 positive ≤14 days before or ≤7 days after surgery	Reflects viral replication phase, maximal systemic inflammation
Recent	15–42 days from positive test to surgery	Convalescent window; residual immune dysregulation and hypercoagulability
Prior (Remote)	>42 days from positive test to surgery	Recovery phase; risk may approach baseline in vaccinated patients

Results

Overall Burden of Perioperative COVID-19 (2023–2026 Evidence)

A large single-centre retrospective cohort study from China (Zhan et al., BMJ Open, 2025) analysed 3,571 surgical patients during the Omicron wave (December 2022–February 2023), with 92.9% vaccinated against COVID-19. Overall, 11.76% of patients experienced 30-day postoperative complications. Postoperative COVID-19 carried a slightly higher complication rate (13.90%) compared to preoperative infection (11.44%) or no infection (10.74%). The risk exhibited a bell-shaped time-dependent pattern, peaking when infection occurred closest to the surgical date, and diminishing as the interval extended.[10]

A matched cohort study published in Annals of Surgery (Leeds et al., 2024) examined 82,815 US Veterans Affairs patients undergoing surgery from April 2020 to September 2022, of whom 16,563 (20%) had prior lab-confirmed SARS-CoV-2 infection. Overall 90-day mortality was comparable between infected (2.5%) and uninfected (2.3%) patients when infection had occurred more than 14 days prior to surgery. Across the full pandemic period analysed, overall 30-day complication rates were 5.2% versus 4.6% for infected and uninfected patients, respectively.[7]

A concurrent Indian matched cohort study (Cureus, 2024) specifically examined emergency surgery patients and found 30-day mortality of 23% in COVID-19-positive patients versus 1.2% in matched

controls — a 12.3-fold elevated risk. This dramatic difference underscores the compounded impact of concurrent acute infection and emergency operative stress.[11]

Outcomes Stratified by Infection Timing

Active Infection (≤14 Days)

The 2025 BMJ Open study (Zhan et al.) established granular weekly risk estimates. Preoperative infection within the first week (pre-1w) carried the highest adjusted odds ratio (aOR) for postoperative complications at 2.67 (95% CI 1.50–4.78). Infection diagnosed 1–2 weeks pre-operatively (pre-2w) carried aOR 2.14 (95% CI 1.20–3.80).[10]

The Leeds et al. VA study corroborated this, demonstrating that only patients operated within 14 days of a positive test had significantly elevated 90-day mortality (OR 1.40, 95% CI 1.08–1.86) and 30-day complications (OR 1.32, 95% CI 1.11–1.57). Critically, this risk was confined to patients with ASA class 4–5; those with ASA 1–3 demonstrated no increased risk at any interval, including under 14 days.[7]

A propensity-matched study examining Omicron-era patients (Int. J. Med. Sci., 2024) found that surgery within 0–7 days and 8–14 days of Omicron infection did not significantly increase most complications (including pulmonary, DVT, sepsis) in a largely vaccinated contemporary cohort — with the exception of renal insufficiency in the 8–14-day subgroup. This suggests that the pathological potency of active COVID-19 in the surgical setting has substantially attenuated with newer variants and higher population immunity.[8]

Recent Infection (15–42 Days)

Risk attenuation within this window is the key finding differentiating 2023–2026 evidence from earlier pandemic data. The BMJ Open 2025 study found that surgical risk at 2–3 weeks pre-operatively (pre-3w: aOR 1.27, p=0.46) and beyond 3 weeks (pre-4w+: aOR 1.24, p=0.15) was no longer statistically significant compared to uninfected controls.[10]

The Annals of Surgery VA study showed no elevated risk at 15–28 days, 29–42 days, or beyond 42 days after infection for the full cohort and for ASA 1–3 patients specifically. However, high-comorbidity patients (ASA 4–5) operated within 14 days — not 15–42 days — retained elevated risk, suggesting the 14-day threshold is clinically actionable specifically for this subgroup.[7]

A case-control study by Ramos et al. (Updates in Surgery, 2024) involving vaccinated patients who underwent surgery between November 2021 and March 2022 found no significant difference in 30-day postoperative mortality or complications between COVID-19-positive and matched COVID-19-negative patients when infection preceded surgery by at least a short interval in a predominantly vaccinated population. This finding contrasted sharply with earlier unvaccinated cohorts and reinforced the protective role of vaccination in modulating perioperative risk.[12]

Prior/Remote Infection (>42 Days)

Beyond 42 days, the evidence consistently indicates a return to baseline surgical risk for the majority of patients, provided acute symptoms have resolved. A COVIDSurg/GlobalSurg Collaborative international prospective cohort of 140,231 patients originally established that surgery delayed >7 weeks from diagnosis had no increased 30-day postoperative mortality except in patients with ongoing symptoms. Contemporary 2024–2025 data have largely confirmed this risk normalization, with the 7-week threshold now regarded as overly conservative for vaccinated, low-comorbidity patients.[6][7]

The critical exception concerns patients with Long COVID or post-acute sequelae of SARS-CoV-2 (PASC). A 2026 PMC review noted that persistent abnormalities on pulmonary function testing and echocardiography, reduced functional capacity, and neurocognitive deficits may persist months after acute infection. For these patients, standard surgical risk calculators underestimate perioperative risk, and the timeline of >42 days does not reliably confer safety.[13][14]

Summary of Timing-Stratified Risk Estimates

Timing Stratum	Pre-op Infection aOR (Complications)	Post-op Infection aOR (Complications)	Mortality Risk	Evidence Level
Active: ≤7 days	2.67 (1.50–4.78)	2.48 (1.48–4.13)	High (especially emergency)	Moderate (RCT-level cohort)
Active: 8–14 days	2.14 (1.20–3.80)	1.95 (1.10–3.45)	Elevated, ASA 4–5 only	Moderate
Recent: 15–21 days	1.27 (0.67–2.39) NS	2.25 (1.27–3.98)	Low to moderate	Moderate
Recent: 22–42 days	1.24 (0.92–1.68) NS	1.24 (0.72–2.14) NS	Near-baseline	Moderate
Prior: >42 days	Not significant	Not applicable	Baseline (except Long COVID)	High

**aOR = adjusted odds ratio; NS = not statistically significant; data derived from BMJ Open 2025 and Ann Surg 2024 *[7][10]*

Elective vs. Emergency Surgery: Comparative Outcomes

Elective Surgery

Elective surgical outcomes improved substantially in the post-vaccine, Omicron era. The Ramos et al. study of vaccinated patients undergoing elective surgery found no excess mortality or major complication rates attributable to perioperative SARS-CoV-2 infection. A systematic review and meta-analysis of breast cancer surgery (J. Clin. Med., 2026, covering 2020–2024 prospective data) found that overall 30-day postoperative mortality was comparable to pre-pandemic benchmarks (pooled rate 0.3%, 95% CI 0.1–0.6%) when surgery was performed ≥2 weeks after infection.[15][12]

Oncological elective surgery represented a specific dilemma: delays beyond 35 days were associated with significantly increased tumor upstaging (OR 1.91, 95% CI 1.15–3.18), reinforcing the need for timely surgical intervention even in a COVID-19 context. Colorectal oncology surgery outcomes during the pandemic were not significantly different from pre-pandemic benchmarks when elective procedures were maintained.[16][17][15]

The sensitivity analysis from the BMJ Open 2025 Omicron-era study confirmed that findings in elective-only patients were consistent with the full study population, supporting the generalizability of timing-based risk estimates to the elective surgical context.[10]

Emergency Surgery

Emergency surgery in COVID-19-positive patients consistently carries far greater mortality and morbidity than elective procedures across all pandemic phases. The AIIMS Bhopal matched cohort study (Cureus, 2024) reported 30-day mortality of 23% versus 1.2% (HR 12.3, 95% CI 1.55–97.2) in COVID-positive versus matched COVID-negative emergency surgical patients. Postoperative ARDS (20.9% vs. 9.3%), sepsis (26% vs. 5.8%), and shock (26% vs. 3.5%) were all significantly higher in the COVID-19 cohort.[18][11]

A retrospective analysis of emergency surgical conditions from India (Int. Surgery J., 2023) of 50 emergency surgical patients showed mortality of 32% in COVID-positive versus 8% in COVID-negative patients, with a 2.88-fold greater incidence of multi-organ dysfunction syndrome. Hospital stay was significantly prolonged: 11.78 days versus 8.43 days.[18]

Analysis of NHS England data from the first COVID-19 wave confirmed that 90-day mortality after emergency admissions during the lockdown period (2020) was significantly higher than 2019 pre-pandemic controls across all common acute surgical conditions — including gallstone disease (OR 2.66, 95% CI 1.81–3.92), diverticular disease (OR 1.99, 95% CI 1.44–2.74), and hernia (OR 1.70, 95% CI 1.13–2.55).[19]

Crucially, the 7-week delay recommendation from COVIDSurg was designed primarily for elective surgery and explicitly cannot be applied to emergency surgical settings, where physiological urgency precludes delays. Predictors of mortality in emergency COVID-19 surgical patients include ASA class III–IV (HR 36.6), preoperative dyspnea (HR 5.6), ARDS (HR 9.1), elevated SOFA score, raised creatinine and bilirubin, and low albumin.[11]

Elective vs. Emergency Outcomes Comparison

Outcome Metric	Elective Surgery (COVID+)	Emergency Surgery (COVID+)	Evidence Source
30-day mortality	0.3–1.2% (if ≥2 wks delay, vaccinated)	18–32%	[15][11][18]
Postoperative ARDS	5–10%	20–22%	[11][20]
Sepsis rate	~5–10%	26%	[11]
Mean hospital stay	6–11 days	12–22 days	[20][18]
ICU admission rate	~10–17%	19–33%	[20][11]
Mortality vs. controls	1.0–2.0×	6–12.3×	[7][11]

Specific Complication Domains

Pulmonary Complications

Pulmonary complications remain the primary driver of postoperative mortality in COVID-19-positive surgical patients. The 2020 COVIDSurg landmark study showed 51.2% pulmonary complication rates with 30-day mortality of 38% among affected patients. In the contemporary Omicron era, this rate has declined but remains clinically significant, particularly in emergency settings where ARDS rates of 20.9% were documented in 2024.[3][11]

Thromboembolic Complications

A 2025 systematic review (BJS Open) demonstrated consistent increased VTE rates in perioperative COVID-19-positive patients, particularly in orthopedic surgery (1.53-fold unadjusted increase) and emergency general surgery (4.80-fold increase). For patients operated within 1–6 weeks of COVID-19 diagnosis, VTE risk was significantly elevated, with DVT risk rising up to 3 months and pulmonary embolism risk up to 6 months post-infection.[21][22][23]

Metabolic and Renal Complications

COVID-19 causes multi-organ sequelae that extend surgical risk beyond the cardiopulmonary domain. Acute kidney injury, persistent hyperglycemia, and hepatic dysfunction were documented at significantly higher rates in COVID-19 emergency surgical patients. In the Omicron Zhan et al. study, AKI accounted for the most common individual complication (6.08%), followed by respiratory (3.78%) and cardiovascular events (3.70%).[11][10]

Long COVID and Perioperative Risk

Approximately 1 in 33 patients in the UK report ongoing symptoms post-COVID-19 infection. Long COVID (PASC) presents unique perioperative challenges: persistent pulmonary function abnormalities, reduced cardiorespiratory reserve, autonomic dysfunction (postural tachycardia syndrome), and neurocognitive impairment affecting informed consent quality, delirium risk, and postoperative cognitive dysfunction.[24][14][25]

A 2026 PMC review on anesthesia in long COVID patients emphasized that lung-protective ventilation strategies, careful hemodynamic management, and close postoperative monitoring are essential for this population. Preoperative pulmonary function testing and echocardiography should be standard in long COVID patients, even those presenting >7 weeks after acute infection. Long COVID patients operated electively at an Australian centre (Annals of Surgery, 2024) had outcomes

that correlated with the degree of functional impairment rather than simply the timing from acute infection.[26][14][25][13]

Impact of Vaccination on Surgical Outcomes

Vaccination has emerged as the single most impactful modifier of perioperative COVID-19 risk. A 2024 landmark study published in the Annals of Surgery and highlighted by SUNY Downstate found that vaccinated patients showed no significant difference in postoperative mortality risk regardless of COVID-19 diagnosis timing before surgery. This represented a fundamental departure from unvaccinated-era findings.[27]

A 2024 study of major vascular surgery patients (Annals of Surgery, 2024) confirmed that preoperative COVID-19 vaccination was associated with decreased perioperative mortality in a multicenter analysis. In cardiac surgery, a national registry study from Israel demonstrated that vaccination neutralized the excess 30-day mortality associated with perioperative COVID-19 that had been present in the pre-vaccine era. The Omicron-era cohort from China (Zhan et al.) found 92.9% vaccination coverage; stratification showed vaccinated patients retained some risk within the first 2 weeks but far less than non-vaccinated equivalents.[28][29][10]

Guideline Evolution (2023–2026)

Organization	Prior Recommendation	2023 Update	Key Change
ASA/APSF (USA)	7 weeks for elective surgery	2–7 weeks, individualized; shared decision-making	Risk stratification replaces fixed 7-week rule [9]
ANZCA (Australia/NZ)	7 weeks	2–3 weeks for most patients; individualized for high-risk	Reflects Omicron attenuation and vaccination [30]
COVIDSurg Collaborative	7 weeks based on 2020–2021 data	Updated to shorter intervals for vaccinated patients	Ongoing research basis
CPOC (UK)	7 weeks; longer if symptomatic	Maintained 7 weeks for high-risk; flexible for low-risk	Persistent symptoms = prolonged delay [31]

Discussion

The 2023–2026 evidence base compels a significant paradigm revision in the perioperative management of COVID-19 patients. The critical determinants of postoperative risk are no longer dichotomous (COVID-positive vs. COVID-negative) but are multi-dimensional, encompassing infection timing, disease severity, vaccination status, surgical urgency, comorbidity burden, and variant-specific pathogenicity.

The pivotal contribution of the Leeds et al. Annals of Surgery 2024 study is its demonstration, across 82,815 procedures spanning the pandemic arc, that for the vast majority of patients (ASA 1–3), surgery after 14 days of SARS-CoV-2 diagnosis carries no excess mortality or complication risk — a finding that directly challenges the blanket 7-week delay standard. This has been corroborated by the Omicron-specific Zhan et al. 2025 study, which showed risk normalization beyond 2–3 weeks in the largely vaccinated Chinese cohort.[7][10]

The emergency surgery landscape presents a starkly different scenario. Unlike elective settings where timing is modifiable, emergency surgery cannot be deferred, and the compounded physiological insults of acute COVID-19 infection plus operative stress result in synergistic immune dysregulation, hypercoagulability, multi-organ strain, and cytokine amplification. A mortality rate approaching 23–32% in contemporary COVID-19-positive emergency surgical patients, compared to 1–8% in matched controls, demands immediate protocol development for this population. Key strategies include heightened pre- and intraoperative monitoring, aggressive lung-protective ventilation, early

ICU surveillance, thromboprophylaxis escalation, and intensive management of organ-specific biomarkers (creatinine, albumin, bilirubin).[32][18][11]

The emerging long COVID burden introduces a new and persistent surgical risk category that will outlast the acute pandemic phase. With over 30% of COVID-19 survivors in some cohorts reporting ongoing symptoms, and perioperative neurocognitive dysfunction well-established even in COVID-naive patients, the intersection of PASC and surgery represents a compounding risk that current guidelines inadequately address. Structured preoperative assessment tools for long COVID patients, incorporating pulmonary function, cardiac evaluation, functional capacity (6-minute walk test, CPEX), and neurocognitive screening, are recommended prior to major elective surgery.[14][13][24]

Pediatric surgical populations consistently demonstrate significantly more favourable outcomes than adults with perioperative COVID-19 infection, with low complication rates (7%), minimal mortality, and rapid recovery reflecting the milder COVID-19 phenotype in children. This population-specific resilience supports less restrictive timing policies for pediatric elective surgery.[33]

The geographic and socioeconomic stratification of perioperative COVID-19 mortality remains critical. Surgical patients in low- and middle-income countries (LMICs) faced mortality risks nearly double those of high-income settings (RR 16.04 vs. 7.50), driven by resource limitations, delayed presentation, and reduced vaccine access. As SARS-CoV-2 becomes endemic and new variants emerge, this disparity demands global surgical infrastructure investment.[1]

Conclusion

The past three years have transformed the understanding of COVID-19's impact on surgical outcomes. Active perioperative infection — particularly within 14 days of surgery — remains a significant independent predictor of postoperative complications and mortality, especially in emergency settings and high-comorbidity patients (ASA 4–5). However, vaccination, Omicron variant attenuation, and hybrid immunity have substantially reduced but not eliminated this risk. The evidence no longer supports a blanket 7-week surgical delay for all COVID-19-recovered patients; instead, a 14–21-day minimum delay for lower-risk elective candidates, guided by shared decision-making and individualized risk stratification, has emerged as clinically sound and evidence-based practice. Emergency surgery retains exceptional perioperative hazard that cannot be mitigated by timing and requires robust critical care preparedness. Long COVID's perioperative implications are becoming an increasingly prominent clinical frontier, demanding structured multidisciplinary preoperative evaluation. As SARS-CoV-2 transitions into endemicity, surgical departments must implement adaptive, evidence-driven protocols that integrate COVID-19 infection history alongside classical risk factors to optimize patient safety in the new perioperative landscape.

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