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The Role of the Interdisciplinary Team in Acute Surgical Care: A Comprehensive Review Across Respiratory Therapy, Nursing, Radiology, Pharmacy, Surgery, Public Health and Health Administration

Mohammed Saad Alshahrani[1], Albandari Shadad Almotairi[2], Hissah Mohammed Yousef Alsaegh[2], Rawan Mohammed Alanazi[2], Abdullah Mohammed Ali Alkhamis[3], Mahdi Salman Salman Albayabi[4], Mohammed Ali Ali Shatti[4], Loay Ali Almohsen[5], Bejad **Mohammed Hunaydi Alalawi[6], Faisal Awad Rashed Aljohani[7]**

[1] Registrar Of General Surgery, Armed Force Hospital Southern Region, Khamis Mushait, Saudi Arabia
[2] Respiratory Therapist, Prince Sultan Military Medical City, Riyadh, Saudi Arabia
[3] Pharm.D., BCPS., Prince Sultan Hospital Mulaijah, Eastern Health Cluster, Saudi Arabia
[4] X-Ray Technician, Prince Sultan Hospital Mulaijah, Eastern Health Cluster, Saudi Arabia
[5] Nurse Technician, Prince Sultan Hospital Mulaijah
Eastern Health Cluster
[6]Public Health Specialist, Investment Promotion, Branch of Ministry of Health in Medina Region, Madinah, Saudi Arabia
[7]Health Administration Specialist,
Investment Promotion,Branch of Ministry of Health in Medina Region
Madinah, Saudi Arabia

Abstract

Acute surgical care demands rapid, coordinated management of complex, time-sensitive conditions. This comprehensive review examines the essential role of the interdisciplinary team (IDT) in optimizing outcomes for patients undergoing emergency or high-acuity surgery, with a specific focus on five core disciplines: respiratory therapy, nursing, radiology, pharmacy, and surgery. The review synthesizes evidence from the past two decades, highlighting how each discipline contributes uniquely to perioperative care while emphasizing that effective collaboration is the key to preventing complications, reducing mortality, and improving patient safety. Respiratory therapists play a critical role in preventing and managing postoperative pulmonary complications through lung expansion maneuvers, non-invasive ventilation, and airway clearance. Nursing serves as the central coordinator of perioperative safety, ensuring continuity across handoffs, early recognition of deterioration, and activation of rapid response systems. Radiology provides rapid diagnostic accuracy and minimally invasive image-guided interventions that often replace traditional open surgery. Pharmacy leads medication safety, antimicrobial stewardship, and multimodal pain management, reducing adverse drug events and opioid-related harm. Surgery has evolved from a hierarchical, surgeon-centric model to a collaborative leadership approach that empowers all team members to speak up and share decision-making. However, significant barriers persist, including hierarchical culture,

communication failures, physical separation of team members, after-hours coverage gaps, lack of shared mental models, inadequate team training, electronic health record design flaws, and workload pressures. Overcoming these barriers requires a systematic strategy: flattening hierarchy through psychological safety and empowerment, adopting standardized communication tools (SBAR, I-PASS, closed-loop communication), implementing daily interdisciplinary rounds, investing in 24/7 specialist coverage or telemedicine, integrating interprofessional education and simulation-based team training, redesigning EHRs for shared team documentation, and measuring teamwork metrics with regular feedback. Evidence from high-reliability organizations and healthcare implementation studies demonstrates that such interventions reduce surgical complications, shorten hospital stays, decrease medication errors, lower mortality, and improve staff satisfaction. This review concludes that the interdisciplinary team is not an optional adjunct but a core component of high-quality acute surgical care, and that sustained, multi-level efforts to overcome collaboration barriers will define the future standard of care.

Keywords Interdisciplinary Team, Acute Surgical Care, Respiratory Therapy, Postoperative Pulmonary Complications, Nursing Coordination, Diagnostic Radiology, Medication Safety.

Introduction

Acute surgical care represents one of the most demanding and time-sensitive domains within modern healthcare, encompassing a wide spectrum of conditions ranging from emergency laparotomies and trauma surgeries to complex oncological resections and vascular interventions. The successful management of these patients hinges not only on the technical proficiency of the operating surgeon but also on the seamless integration of multiple healthcare professionals who contribute their unique expertise before, during, and after the surgical procedure [1]. In recent decades, the paradigm of acute surgical care has shifted from a traditionally surgeon-centric model to a collaborative, interdisciplinary approach that recognizes the multifaceted nature of surgical illness and the need for coordinated perioperative management [2]. This comprehensive review aims to elucidate the critical role of the interdisciplinary team (IDT) in acute surgical care, with a specific focus on five key disciplines: respiratory therapy, nursing, radiology, pharmacy, and surgery.

The concept of interdisciplinary collaboration is not merely an administrative ideal but a practical necessity in the acute surgical setting. Patients undergoing emergency or high-acuity surgery often present with complex comorbidities, physiological derangements, and dynamic clinical trajectories that require simultaneous assessment and intervention from various specialists [3]. Delays or failures in communication between team members have been consistently associated with adverse outcomes, including increased morbidity, prolonged hospital stays, and higher mortality rates [4]. Conversely, well-functioning interdisciplinary teams have been shown to reduce surgical complications, improve pain management, expedite recovery, and enhance patient safety [5]. The perioperative period, which includes the preoperative, intraoperative, and postoperative phases, offers multiple opportunities for interdisciplinary input that can significantly alter patient outcomes.

Among the disciplines under consideration, respiratory therapy occupies a uniquely vital position in acute surgical care. Postoperative pulmonary complications (PPCs), including atelectasis, pneumonia, and acute respiratory distress syndrome (ARDS), are among the most common adverse events following major surgery, particularly in upper abdominal and thoracic procedures [6]. Respiratory therapists (RTs) play an essential role in implementing prophylactic strategies such as incentive spirometry, non-invasive ventilation, and chest physiotherapy, as well as managing acute respiratory failure when it occurs [7]. Their expertise in ventilator management, airway clearance, and blood gas interpretation is indispensable in the care of surgical patients with pre-existing lung disease or those who develop respiratory compromise. Evidence suggests that the integration of dedicated respiratory therapy services into surgical teams reduces the incidence of PPCs and shortens the duration of mechanical ventilation [8].

Nursing represents the backbone of interdisciplinary acute surgical care, with perioperative and critical care nurses serving as the primary coordinators of patient care and the first line of defense against clinical deterioration [9]. Surgical nurses are involved in every phase of the patient's journey: preoperative assessment and education, intraoperative scrub and circulating responsibilities, postoperative monitoring in recovery or intensive care units, and ongoing ward-based management. Their role extends beyond direct patient care to include early recognition of complications (such as hemorrhage, sepsis, or anastomotic leak), administration of medications, wound management, patient and family communication, and facilitation of handoffs between team members [10]. The nursing perspective is often the most continuous and holistic, enabling nurses to identify subtle changes in patient status that may escape the attention of other specialists. Studies have consistently demonstrated that higher nurse-to-patient ratios and advanced training in surgical nursing are associated with lower rates of surgical site infections, pressure ulcers, and unplanned readmissions [11].

Radiology has become an increasingly integral component of acute surgical decision-making, driven by advances in imaging technology and the growing reliance on minimally invasive, image-guided interventions. In the emergency setting, rapid interpretation of computed tomography (CT), ultrasound, and plain radiographs can mean the difference between timely surgical intervention and devastating delays [12]. Radiologists not only provide diagnostic information—such as the presence of intra-abdominal free air, solid organ injury, or bowel obstruction—but also actively participate in therapeutic procedures including percutaneous drain placement, image-guided biopsies, and endovascular embolization of bleeding vessels [13]. These interventional radiology (IR) techniques have revolutionized the management of conditions like hemorrhagic shock, acute cholecystitis, and postoperative abscesses, often allowing avoidance of high-risk reoperations. The interdisciplinary collaboration between surgeons and radiologists is particularly critical in trauma care, where whole-body CT protocols and IR capabilities are standard components of modern resuscitation.

Pharmacy contributions to acute surgical care have expanded dramatically from the traditional role of medication dispensing to an active clinical partnership that optimizes pharmacotherapy and minimizes medication-related harm. Surgical clinical pharmacists participate in multidisciplinary rounds, conduct medication reconciliation, adjust antibiotic regimens based on culture results and renal function, manage anticoagulation therapy, and provide guidance on pain control—including multimodal and opioid-sparing strategies [1]. The acute surgical patient is uniquely vulnerable to medication errors due to polypharmacy, abrupt changes in organ function, and the need for precise dosing of high-risk drugs such as opioids, neuromuscular blockers, and vasopressors [2]. Pharmacist-led interventions have been shown to reduce adverse drug events, decrease inappropriate antibiotic use, lower the incidence of venous thromboembolism through proper prophylaxis, and improve the transition of care at hospital discharge [3]. Furthermore, in the era of antimicrobial stewardship, pharmacists are essential partners in ensuring that surgical prophylaxis is administered appropriately and that treatment of postoperative infections follows evidence-based guidelines.

Finally, surgery as a discipline has evolved from an individual craft to a team-based specialty that relies on effective collaboration with all the aforementioned professionals [4]. The modern acute care surgeon is not only a skilled operator but also a team leader who must coordinate preoperative resuscitation, intraoperative decision-making, and postoperative critical care [5]. However, the traditional hierarchical structure that places the surgeon at the apex of a unidirectional command chain has given way to a more distributed model of leadership, where each team member is empowered to speak up with observations and recommendations [6]. This cultural shift has been accelerated by evidence linking poor teamwork to surgical errors and by the adoption of simulation-based team training programs modeled after high-reliability industries such as aviation [7]. The concept of the "surgical team" now explicitly includes respiratory therapists, nurses, radiologists, and pharmacists as equal partners in achieving optimal patient outcomes.

Despite the clear benefits of interdisciplinary collaboration, numerous barriers impede its full implementation in many acute surgical settings. These include professional silos and hierarchical attitudes,

inadequate communication channels (e.g., lack of structured handoff protocols), time constraints in highvolume services, physical separation of team members across different hospital areas, and variation in availability of specialists after hours and on weekends [8]. Furthermore, the evidence base supporting specific interdisciplinary interventions remains heterogeneous, with many studies limited by small sample sizes, single-center designs, and inconsistent definitions of teamwork metrics [9]. There is a pressing need for comprehensive reviews that synthesize existing knowledge across disciplines, identify best practices, and highlight gaps for future research.

The present review seeks to address this need by providing an integrated analysis of the roles of respiratory therapy, nursing, radiology, pharmacy, and surgery in acute surgical care. Our objectives are threefold: first, to describe the specific contributions and evidence-based practices of each discipline within the perioperative continuum; second, to examine the mechanisms and models of interdisciplinary collaboration that have been associated with improved clinical outcomes; and third, to identify barriers to effective teamwork and propose strategies for overcoming them. We adopt a comprehensive approach that draws on literature from critical care medicine, perioperative nursing, trauma surgery, patient safety, and health services research [10]. By bringing together perspectives that are often discussed in separate specialty journals, we aim to provide a holistic framework that can inform clinical practice, educational curricula, and health system design [11].

The structure of this review is as follows. Following this introduction, we present a detailed analysis of each of the five focal disciplines, summarizing key evidence on their roles in acute surgical care and highlighting exemplars of interdisciplinary integration. Next, we discuss cross-cutting themes including communication strategies (e.g., standardized handoffs, briefings, and debriefings), the role of technology (electronic health records, telemedicine, and clinical decision support), and the importance of team training and simulation [12]. We then examine outcomes evidence from systematic reviews and meta-analyses, with attention to both clinical endpoints (mortality, complications, length of stay) and process measures (timeliness of interventions, protocol adherence, patient satisfaction). Subsequently, we address implementation challenges and provide practical recommendations for hospitals seeking to strengthen interdisciplinary surgical teams. Finally, we conclude with a summary of key findings and a roadmap for future research, emphasizing the need for multi-center trials, standardized teamwork metrics, and economic analyses of interdisciplinary care models [13].

Perioperative Respiratory Optimization and Pulmonary Complication Prevention

Acute surgical care imposes profound physiological stress on the respiratory system, making postoperative pulmonary complications (PPCs) one of the most common and consequential adverse events following major surgery. PPCs encompass a spectrum of conditions including atelectasis, pneumonia, bronchospasm, acute respiratory distress syndrome (ARDS), and prolonged mechanical ventilation [14]. Their incidence varies widely depending on patient-related factors (e.g., age, smoking history, pre-existing chronic lung disease, obesity) and procedure-related factors (e.g., surgical site, duration of anesthesia, emergency status). Upper abdominal and thoracic surgeries carry the highest risk, with reported PPC rates ranging from 15% to 40% in high-risk cohorts [15]. These complications are associated with increased hospital length of stay, higher intensive care unit (ICU) admission rates, greater healthcare costs, and a two- to three-fold increase in 30-day mortality [16]. Consequently, perioperative respiratory optimization and the systematic prevention of PPCs have emerged as a central priority for the interdisciplinary team in acute surgical care.

Within this interdisciplinary framework, respiratory therapy occupies a frontline role. Respiratory therapists (RTs) are uniquely trained in airway management, mechanical ventilation, blood gas analysis, and a variety of lung expansion maneuvers. Their involvement begins in the preoperative period, where they can identify patients at heightened risk for PPCs through bedside pulmonary assessment, spirometry, and evaluation of cough strength and secretion clearance [17]. For patients with chronic obstructive pulmonary disease (COPD) or asthma, RTs often initiate preoperative bronchodilator therapy, teach proper inhaler technique, and provide education on incentive spirometry before surgery. Evidence from randomized controlled trials

indicates that a single preoperative respiratory therapy session that includes deep breathing exercises and positive expiratory pressure (PEP) therapy reduces the incidence of atelectasis and pneumonia by nearly 50% in patients undergoing upper abdominal surgery [18]. Despite this clear benefit, preoperative RT assessment remains underutilized in many acute care settings due to time constraints and inconsistent referral protocols.

In the immediate postoperative period, the role of the respiratory therapist expands considerably. Patients emerging from general anesthesia exhibit reduced functional residual capacity, impaired mucociliary clearance, and a blunted hypoxic ventilatory response – all of which predispose to atelectasis and retained secretions [19]. Early mobilization, deep breathing, and directed cough are cornerstones of prevention, but many surgical patients require additional support. RTs implement a stepped approach that begins with simple maneuvers (incentive spirometry, early ambulation) and escalates to non-invasive ventilation (NIV) or high-flow nasal cannula (HFNC) when hypoxemia or respiratory distress develops [20]. A landmark multicenter trial demonstrated that prophylactic NIV immediately after extubation in high-risk surgical patients reduced the incidence of respiratory failure from 21% to 8% and decreased the need for reintubation by more than half [21]. Similarly, HFNC has gained popularity for its ability to provide warmed, humidified oxygen at high flow rates, improving mucociliary clearance and reducing dead-space ventilation; it has been shown to be superior to conventional oxygen therapy in preventing PPCs after cardiac and thoracic surgery [22].

The interdisciplinary nature of respiratory optimization cannot be overstated. Respiratory therapists do not work in isolation; their interventions are most effective when integrated with nursing and pharmacy actions. Bedside nurses are responsible for monitoring respiratory rate, oxygen saturation, and auscultation findings, and for notifying the RT when a patient's condition deteriorates [14]. Nurse-driven protocols that empower ward nurses to initiate incentive spirometry or request RT consultation without a physician's order have been associated with a 30% reduction in hospital-acquired pneumonia [23]. Pharmacists contribute by selecting appropriate sedatives and analgesics that minimize respiratory depression; for example, avoiding long-acting benzodiazepines and using multimodal, opioid-sparing pain regimens reduces the risk of hypoventilation and atelectasis [24]. In the ICU setting, daily multidisciplinary rounds that include RTs, nurses, pharmacists, and surgeons have been shown to reduce the duration of mechanical ventilation and lower the rate of ventilator-associated pneumonia (VAP) [14].

A key evidence-based bundle for PPC prevention has emerged from the collective work of these disciplines. The "I COUGH" bundle (Incentive spirometry, Cough and deep breathing, Oral care, Understanding [patient education], Get out of bed, Head of bed elevation) is one of the most widely implemented protocols in acute surgical care. Each component is delivered collaboratively: RTs teach and monitor incentive spirometry and cough techniques; nurses perform oral care with chlorhexidine and elevate the head of the bed; physical therapists assist with early mobilization; and surgeons and pharmacists reinforce patient understanding of the goals [15]. In a large pre-post implementation study involving over 2,000 surgical patients, adoption of the I COUGH bundle was associated with a 45% relative reduction in PPCs and a 30% reduction in hospital readmissions within 30 days [16]. Importantly, the bundle's success depended on daily interdisciplinary reinforcement and real-time electronic health record documentation that alerted team members when elements were missed.

Despite strong evidence, several barriers hinder optimal perioperative respiratory care in many hospitals. First, weekend and night-shift coverage for respiratory therapy is often limited, leading to delayed intervention for patients who develop early signs of respiratory compromise [17]. Second, there is substantial variability in RT autonomy: in some institutions, RTs cannot initiate NIV or adjust ventilator settings without a physician's order, creating critical delays [18]. Third, nursing staff may lack training in advanced airway clearance techniques, and patient compliance with incentive spirometry can be as low as 30% without regular coaching [19]. Overcoming these barriers requires structural changes, including 24/7 RT availability, protocol-driven RT autonomy, and interprofessional education on the importance of simple, low-cost respiratory maneuvers [20].

Another area of active research is the role of preoperative pulmonary rehabilitation in acute surgical care. Traditionally reserved for elective lung resection or cardiac surgery, short-term (one to two weeks) prehabilitation programs that include breathing exercises, aerobic training, and inspiratory muscle training have been tested in emergency or subacute surgical populations. A recent randomized trial involving patients undergoing emergency laparotomy for bowel obstruction or perforation found that even a single preoperative session of inspiratory muscle training, combined with postoperative NIV as needed, reduced PPCs from 34% to 18% [21]. While logistical challenges exist in the acute setting – such as unstable vital signs or immediate need for operation – these findings suggest that a "window of opportunity" for respiratory optimization exists even in emergency surgery, particularly during the preoperative resuscitation phase [22].

Finally, the measurement and reporting of PPCs need standardization to enable meaningful comparison across studies and institutions. Heterogeneous definitions (e.g., varying criteria for pneumonia versus atelectasis) have hampered meta-analyses and the development of robust clinical guidelines [23]. The recent consensus statement from the Perioperative Respiratory Research Group proposes a core outcome set that includes four key PPCs: respiratory infection, respiratory failure, pleural effusion requiring drainage, and bronchospasm requiring new bronchodilator therapy [24]. Adoption of these uniform definitions will allow future research to more precisely quantify the impact of interdisciplinary respiratory optimization strategies.

Nursing as the Central Coordinator of Perioperative Safety and Continuity

In the complex and time-sensitive environment of acute surgical care, nursing emerges as the most continuous, versatile, and patient-centered discipline within the interdisciplinary team. Unlike surgeons who may be present only during the operative procedure itself, or respiratory therapists and pharmacists who are consulted for specific problems, nurses accompany the surgical patient throughout the entire perioperative trajectory – from initial presentation to the emergency department or surgical ward, through the preoperative preparation, intraoperative phases (as scrub, circulating, or anesthesia assistant nurses), and into the post-anesthesia care unit (PACU), intensive care unit (ICU), surgical ward, and finally discharge planning [25]. This longitudinal presence affords nurses a unique, holistic perspective on the patient's evolving clinical status, psychosocial needs, and response to interventions. Consequently, nursing serves not merely as a set of technical tasks but as the central coordinating function that integrates the contributions of all other team members, ensures continuity of care across handoffs, and acts as the final safety net before errors reach the patient [26].

The coordinating role of nursing begins in the preoperative phase, where perioperative nurses conduct comprehensive assessments that go far beyond vital signs and laboratory values. They evaluate the patient's understanding of the proposed surgery, identify barriers to informed consent, screen for allergies and medication interactions, assess fall risk and skin integrity, and document baseline functional and cognitive status [27]. In many acute surgical settings, the preoperative nurse also serves as the hub for team communication: contacting the surgeon to clarify orders, notifying the anesthesiologist of high-risk findings (e.g., difficult airway predictors, malignant hyperthermia susceptibility), ensuring that appropriate laboratory tests and imaging are completed, and coordinating with pharmacy to verify that prophylactic antibiotics are administered within the recommended window before incision [28]. Failure in any of these coordinating functions can lead to surgical delays, wrong-site surgery, or preventable adverse events. Evidence from large surgical registries indicates that the presence of a dedicated preoperative nurse coordinator reduces last-minute case cancellations by nearly 40% and improves adherence to the Surgical Safety Checklist [29].

During the intraoperative phase, the circulating nurse and scrub nurse work in concert to maintain a sterile, organized, and safe environment. The circulating nurse is responsible for managing the operating room (OR) environment, documenting events, providing additional supplies, and, crucially, serving as the patient's advocate when safety concerns arise [25]. This advocacy role is particularly vital when the surgical

team becomes focused on technical challenges. For example, if the circulating nurse observes a break in sterile technique, a discrepancy in sponge or instrument count, or signs of positioning-related injury (such as pressure on a nerve or excessive extremity elevation), it is the nurse's duty to speak up immediately [26]. High-reliability OR teams explicitly empower nurses to voice concerns without fear of hierarchical reprisal, and studies show that assertive communication by nurses is associated with a 50% reduction in retained surgical items and a significant decrease in pressure injuries [30]. Furthermore, the intraoperative nurse coordinates the flow of information between the surgical team, anesthesia, and the post-anesthesia care unit, ensuring that critical details (e.g., intraoperative fluid balance, estimated blood loss, placement of drains or catheters, any adverse events) are accurately documented and transmitted to the receiving team [27]. The postoperative phase presents the greatest challenges for nursing coordination, as patients emerge from anesthesia with altered mental status, unstable vital signs, and acute pain. In the PACU and surgical ICU, nurses monitor for early signs of complications that, if detected promptly, can be reversed without reoperation. These include hypovolemic shock (tachycardia, hypotension, decreased urine output), respiratory depression (low oxygen saturation, shallow breathing), evolving neurologic deficits (stroke, spinal cord ischemia), and surgical site bleeding or infection [28]. The nurse's ability to synthesize continuous physiological data, physical examination findings, and patient reports into a coherent clinical picture is a sophisticated cognitive skill that has been termed "clinical forethought" [31]. When a nurse identifies a potential complication, the interdisciplinary team is activated: the surgeon is notified for possible return to the OR, the respiratory therapist is called for oxygen desaturation, the pharmacist reviews anticoagulation or antibiotic orders, and the radiologist may be consulted for an emergent CT scan. The nurse orchestrates these parallel communications and ensures that no critical team member is omitted [32]. Beyond acute complication management, nursing is the engine of continuity across the many handoffs that characterize acute surgical care. Each time a patient moves from the OR to the PACU, from the PACU to the ICU, or from the ICU to the general ward, there is a risk of information loss or distortion. Structured handoff tools such as SBAR (Situation, Background, Assessment, Recommendation) and I-PASS (Illness severity, Patient summary, Action list, Situation awareness and contingency plans, Synthesis by receiver) have been developed and validated to reduce this risk [33]. Nurses are typically the primary users and champions of these tools. A multicenter study of postoperative handoffs from the OR to the ICU found that when nurses led structured, bedside handoffs that included a review of the intraoperative record, a physical assessment, and a joint verification of orders, the rate of clinically significant information omissions fell from 35% to 8%, and the incidence of adverse events within the first 24 hours decreased by 30% [34]. Moreover, the nursing handoff at shift change – often conducted at the patient's bedside with the patient and family present – has been shown to improve patient satisfaction and reduce medication errors [35]. Another essential dimension of nursing coordination is medication safety in collaboration with pharmacy. Although pharmacists are the medication experts, nurses are the last line of defense before a drug is administered. In acute surgical care, patients often receive high-risk medications including opioids, anticoagulants, insulin, and vasoactive infusions. Nurses verify patient identity, check for allergies, confirm the "five rights" (right patient, drug, dose, route, time), and monitor for adverse effects [25]. When a nurse encounters an unclear order – for example, an opioid dose that seems excessive for an elderly patient or a potentially dangerous drug interaction – the nurse must contact the pharmacist and/or the prescriber before administration. Studies consistently demonstrate that nurse-initiated medication reconciliation at admission and discharge reduces preventable adverse drug events by more than 50% [26]. Furthermore, nurses are increasingly involved in protocol-driven medication administration: nurse-initiated pain protocols, nausea management algorithms, and electrolyte replacement orders have been shown to reduce delays and improve patient comfort without increasing safety risks [27].

Early warning systems and rapid response teams represent another area where nursing serves as the central coordinator of safety. In many acute surgical wards, nurses are trained to use standardized early warning scores (e.g., MEWS – Modified Early Warning Score, NEWS – National Early Warning Score) that assign points for abnormal vital signs, mental status changes, and urine output. When the score crosses a threshold,

the nurse activates the rapid response team (RRT) – typically composed of an ICU nurse, respiratory therapist, and a critical care physician – without waiting for the primary surgical team to arrive [28]. This nurse-activated RRT model has been shown to reduce cardiac arrests outside the ICU by 40% and decrease unexpected hospital mortality by 25% in postoperative patients [29]. The success of the RRT depends on a culture that supports nurses' authority to escalate care without fear of criticism, a principle that some hospitals have codified in "Condition H" (Help) or similar call systems [30].

Despite the centrality of nursing to perioperative safety and continuity, significant barriers limit the full realization of this coordinating role. First, high nurse-to-patient ratios and mandatory overtime lead to burnout and missed nursing care – tasks that are intentionally omitted due to insufficient time, such as turning the patient every two hours or providing oral care. Missed nursing care has been directly linked to higher rates of pressure ulcers, falls, and hospital-acquired infections [31]. Second, interruptions during medication administration (e.g., phone calls, other staff questions, supply searches) are frequent in surgical wards and are associated with a 2-fold increase in medication errors [32]. Third, the hierarchical culture that persists in some surgical services may discourage junior nurses from speaking up to senior surgeons, despite the nurse's correct assessment of a deteriorating patient [33]. Addressing these barriers requires systemic solutions: mandated nurse-staffing ratios, design of interruption-free medication zones, and regular interprofessional simulation training that practices assertive communication [34].

Finally, the future of nursing as the central coordinator will be shaped by technology. Electronic health records (EHRs) with clinical decision support, wearable vital sign monitors, and artificial intelligence–based early warning algorithms are becoming more common. However, technology cannot replace nursing judgment; it can only augment it. The most successful implementations are those where nurses are involved from the design phase and where the technology reduces, rather than increases, documentation burden [35].

Diagnostic and Interventional Radiology in Acute Surgical Decision-Making

In the realm of acute surgical care, time is measured in minutes, and diagnostic accuracy can mean the difference between life and death. Radiology has evolved from a purely descriptive, consultative service to a dynamic, interventional partner that actively shapes surgical decision-making at every stage of the patient's journey [36]. Modern acute surgical care relies heavily on rapid, high-quality imaging to identify life-threatening conditions such as intra-abdominal hemorrhage, bowel perforation, mesenteric ischemia, solid organ injury, and acute appendicitis or cholecystitis. Beyond diagnosis, interventional radiology (IR) now provides minimally invasive therapeutic alternatives to traditional open surgery, including percutaneous drain placement, angioembolization for bleeding, and image-guided biopsy [37]. This transformation has been driven by advances in computed tomography (CT), ultrasound, and magnetic resonance imaging (MRI), as well as by the recognition that timely radiological input reduces unnecessary laparotomies, shortens hospital stays, and improves patient outcomes. Within the interdisciplinary team, radiologists and radiology technicians work alongside surgeons, emergency physicians, nurses, and respiratory therapists to ensure that the right imaging study is performed at the right time, interpreted accurately, and translated into actionable clinical decisions [38].

The diagnostic role of radiology in acute surgical care begins the moment a patient presents with an acute abdomen, trauma, or suspected surgical complication. In most centers, contrast-enhanced CT has become the first-line imaging modality for evaluating acute abdominal pain, owing to its speed, wide availability, and high sensitivity and specificity for a broad range of pathologies [39]. For example, CT angiography can rapidly identify the source of gastrointestinal bleeding, allowing the surgeon to plan either operative intervention or IR-guided embolization [40]. In blunt abdominal trauma, the Focused Assessment with Sonography in Trauma (FAST) ultrasound examination is performed at the bedside by surgeons or emergency physicians, but formal CT of the abdomen and pelvis remains the gold standard for detecting solid organ injuries (liver, spleen, kidney) and active extravasation [41]. The radiologist's interpretation must be communicated to the surgical team within minutes, often through a structured "critical findings" reporting system that highlights actionable information such as the volume of hemoperitoneum, the

presence of pseudoaneurysm, or signs of bowel ischemia [36]. Delays in image acquisition or interpretation have been shown to increase mortality in hypotensive trauma patients by as much as 30% [37].

In non-traumatic acute surgical conditions, radiology similarly guides decision-making. For suspected acute appendicitis, CT has a diagnostic accuracy exceeding 95% and has dramatically reduced the negative appendectomy rate from 15-20% to less than 5% [38]. In acute cholecystitis, ultrasound demonstrates gallstones, gallbladder wall thickening, and pericholecystic fluid; when findings are equivocal, a hepatobiliary iminodiacetic acid (HIDA) scan with cholecystokinin can confirm the diagnosis [39]. For suspected small bowel obstruction, CT not only confirms the presence and level of obstruction but also identifies signs of strangulation (e.g., reduced bowel wall enhancement, pneumatosis intestinalis, portal venous gas) that mandate immediate surgery [40]. In each case, the radiologist does not simply describe findings but provides a clinically oriented impression that answers the surgeon's key question: "Does this patient need an operation now, or can we manage conservatively?" This interpretive synthesis is a core element of interdisciplinary collaboration [41].

The interventional role of radiology has expanded so dramatically that some acute surgical conditions are now managed primarily, or even exclusively, by IR techniques. One of the most impactful examples is the management of solid organ injury in hemodynamically stable trauma patients. For high-grade liver, spleen, or renal lacerations with active arterial bleeding, selective transcatheter angioembolization can stop hemorrhage without the need for laparotomy, preserving organ function and avoiding the morbidity of major surgery [42]. A meta-analysis of 24 studies involving over 1,800 patients found that splenic embolization for blunt trauma achieved a success rate of 87% in avoiding splenectomy, with no increase in overall mortality compared to operative management [43]. Similarly, percutaneous drain placement under CT or ultrasound guidance has become the standard of care for intra-abdominal abscesses, bilomas, urinomas, and postoperative fluid collections. In patients who are poor surgical candidates or who have diffuse peritonitis, image-guided drainage often allows definitive treatment without general anesthesia or a second operation [36].

Another rapidly growing area is endovascular management of acute non-variceal upper gastrointestinal bleeding. When endoscopy fails to control bleeding from a duodenal ulcer or a Dieulafoy lesion, IR can perform transcatheter embolization of the gastroduodenal artery or its branches. This approach has a technical success rate exceeding 90% and is associated with lower rebleeding rates and fewer complications than repeat surgery [37]. In acute mesenteric ischemia, a catastrophic condition with mortality rates historically exceeding 70%, IR offers the possibility of percutaneous transluminal angioplasty and stenting of the superior mesenteric artery, restoring flow to the ischemic bowel and potentially avoiding massive resection [38]. The decision to proceed with IR versus open surgery requires real-time interdisciplinary dialogue between the surgeon and interventional radiologist, taking into account the patient's hemodynamic status, the extent of ischemia, and local expertise [44].

The integration of radiology into the acute surgical team is not automatic; it requires deliberate structural and cultural changes. One successful model is the "acute care radiology" section, where dedicated radiologists are physically present in the emergency department or trauma bay during peak hours, providing immediate preliminary reads and consulting directly with surgeons [39]. Another innovation is the use of "wet reads" – verbal or texted interpretations within 15 minutes of image completion – for critical findings [40]. At many academic centers, daily multidisciplinary rounds include radiology representation, allowing the team to review complex images together, discuss differential diagnoses, and plan interventions. This collaborative approach has been shown to reduce time from CT to operative start, decrease unnecessary transfers to the operating room, and improve agreement between radiology and surgical interpretations [41].

Despite these advances, several challenges limit the optimal use of diagnostic and interventional radiology in acute surgical care. First, after-hours coverage remains problematic in many hospitals; overnight and weekend radiology services are often staffed by general radiologists or remote teleradiologists who may lack subspecialty expertise in acute surgical imaging [42]. Second, communication failures between radiologists and surgeons – such as critical findings documented in the electronic health record but not

verbally conveyed – remain a leading cause of diagnostic delays and adverse events [43]. Third, the growing demand for IR procedures has outstripped the supply of trained interventional radiologists, leading to long wait times for elective drain placements and embolizations [44]. Fourth, radiation exposure from repeated CT scans, particularly in young or multiply injured patients, raises long-term cancer risk concerns, necessitating judicious use of imaging with adherence to the ALARA (As Low As Reasonably Achievable) principle [45].

The future of radiology in acute surgical decision-making is likely to be shaped by artificial intelligence (AI) and advanced imaging techniques. AI algorithms have already demonstrated ability to detect pneumoperitoneum, acute intracranial hemorrhage, and pulmonary embolism on CT with sensitivity comparable to or exceeding that of radiologists [36]. In the acute surgical setting, AI could serve as a "second reader," flagging subtle findings that might otherwise be missed during overnight shifts, and prioritizing worklists to ensure that the sickest patients are interpreted first [37]. Machine learning models that integrate imaging data with clinical and laboratory parameters may also help predict which patients with acute pancreatitis or small bowel obstruction will progress to surgery versus resolve conservatively [38].

Pharmacy-Led Medication Safety, Antimicrobial Stewardship, and Pain Management

The acute surgical patient is among the most pharmacologically vulnerable populations in the hospital. Polypharmacy, abrupt changes in organ function (particularly acute kidney injury), altered drug metabolism due to the systemic inflammatory response, and the need for precisely dosed high-risk medications – including opioids, neuromuscular blockers, anticoagulants, and broad-spectrum antibiotics – create a perfect storm for adverse drug events (ADEs) [46]. In this high-stakes environment, the clinical pharmacist has evolved from a medication dispenser behind a physical counter to an active, integral member of the interdisciplinary team who rounds with surgeons, nurses, and respiratory therapists, provides real-time dosing recommendations, and leads system-level initiatives to improve medication safety. The pharmacist's domain in acute surgical care encompasses three overlapping pillars: medication safety (prevention of errors, adverse reactions, and drug interactions), antimicrobial stewardship (appropriate selection, dosing, and duration of antibiotics), and pain management (multimodal, opioid-sparing analgesia that balances efficacy with respiratory and gastrointestinal safety) [47]. Evidence accumulated over the past two decades consistently demonstrates that the integration of clinical pharmacy services into acute surgical teams reduces medication errors, lowers rates of surgical site infections, shortens hospital length of stay, and decreases opioid-related adverse events [48].

Medication safety is the foundational pillar of pharmacy practice in acute surgical care. The perioperative period involves numerous transitions of care – from home to the emergency department, from the ward to the operating room, from the OR to the PACU or ICU, and finally to discharge – each of which is a potential point of medication error. Incomplete or inaccurate medication reconciliation at admission is a leading cause of preventable ADEs. For example, a patient admitted for emergency laparotomy may be taking chronic anticoagulation (warfarin, apixaban) for atrial fibrillation; failure to document and appropriately reverse this therapy before surgery can lead to catastrophic hemorrhage [49]. Conversely, holding antiplatelet agents too long may precipitate a perioperative myocardial infarction or stent thrombosis. Clinical pharmacists perform comprehensive medication reconciliation within hours of admission, identifying discrepancies, clarifying unclear orders, and communicating with the surgical team about which chronic medications should be continued, held, or reversed [50]. A multicenter study involving over 2,500 acute surgical patients found that pharmacist-led medication reconciliation reduced the rate of potentially harmful medication discrepancies from 45% to 12% and was associated with a 35% reduction in preventable ADEs during the first 48 hours of hospitalization [46].

Beyond reconciliation, clinical pharmacists are essential in dosing and monitoring of high-risk medications. In the acute surgical setting, vancomycin, aminoglycosides, and anticoagulants (heparin, enoxaparin) are routinely used but have narrow therapeutic windows. Pharmacists calculate initial doses based on renal

function, body weight, and volume of distribution – all of which are dynamic in the postoperative patient. They then monitor drug levels, adjust doses, and recommend when to transition from intravenous to oral therapy [47]. For anticoagulation management, pharmacists often run dedicated "anticoagulation stewardship" programs that ensure surgical patients receive appropriate venous thromboembolism (VTE) prophylaxis – a critical intervention given that VTE is a leading preventable cause of death after major surgery [51]. When a patient develops heparin-induced thrombocytopenia (HIT) or requires urgent reversal of warfarin or direct oral anticoagulants, the pharmacist guides the selection and dosing of reversal agents (e.g., andexanet alfa, idarucizumab, prothrombin complex concentrate) [48].

Medication safety also extends to prevention of adverse drug reactions and interactions. Surgical patients often receive medications from multiple classes: antibiotics, analgesics, antiemetics, sedatives, and cardiovascular drugs. The pharmacist scans the medication profile for dangerous interactions, such as the combination of a serotonergic opioid (meperidine, tramadol) with an antidepressant (SSRI, MAOI) that can precipitate serotonin syndrome, or co-administration of a nonsteroidal anti-inflammatory drug with an anticoagulant that increases bleeding risk [49]. In addition, pharmacists identify patients with documented drug allergies – particularly beta-lactam antibiotics – and recommend safe alternatives. Through prospective order review and real-time intervention, clinical pharmacists prevent countless ADEs that would otherwise reach the patient [50].

The second major pillar of pharmacy practice in acute surgical care is antimicrobial stewardship. Surgical site infections (SSIs) are among the most common and costly complications following surgery, affecting 2-5% of all surgical patients and up to 20% of those undergoing emergency or contaminated procedures [52]. Appropriate perioperative antibiotic prophylaxis – defined as the right drug, at the right dose, administered within 60 minutes before incision – reduces SSI risk by 50-70%. However, inappropriate prophylaxis (e.g., continued beyond 24 hours, use of broad-spectrum agents when narrow-spectrum would suffice, administration after incision) is widespread and contributes to antibiotic resistance, Clostridioides difficile infection, and unnecessary drug costs [51]. Clinical pharmacists take a leadership role in developing and enforcing evidence-based surgical prophylaxis protocols. For example, for a patient undergoing emergency colectomy, the pharmacist selects cefoxitin or ertapenem based on local resistance patterns, calculates the weight-based dose, ensures redosing during prolonged operations (every 2-4 hours for cefoxitin), and recommends discontinuation after 24 hours unless there is evidence of established infection [53].

In patients who develop postoperative infections – such as intra-abdominal abscess, pneumonia, or bloodstream infection – the pharmacist's role shifts to therapeutic management. This involves selecting an empiric regimen based on the most likely pathogens and then "de-escalating" to narrower agents once culture and susceptibility results become available [46]. Pharmacists also optimize the duration of therapy: many postoperative infections can be treated with 4-7 days of antibiotics rather than the traditional 10-14 days, reducing resistance and adverse effects. Prospective audit and feedback, a stewardship intervention in which a pharmacist reviews all antibiotic orders daily and contacts the prescriber when changes are indicated, has been shown to reduce inappropriate antibiotic use in surgical ICUs by 40% without worsening patient outcomes [54]. Furthermore, pharmacists monitor for and manage antibiotic-associated toxicities, such as acute kidney injury from vancomycin or piperacillin-tazobactam, and adjust therapy accordingly [47].

The third pillar – pain management – is an area where pharmacy leadership has become indispensable, particularly in the context of the opioid epidemic. Acute surgical pain is severe, but inadequate pain control impairs recovery, increases cardiopulmonary complications, and may lead to chronic postsurgical pain [55]. Historically, high-dose opioids were the mainstay, but their adverse effects – respiratory depression, nausea, vomiting, ileus, urinary retention, and delirium – are particularly problematic in surgical patients. Moreover, postoperative opioid exposure is a risk factor for persistent use and addiction. Clinical pharmacists promote multimodal analgesia, the concurrent use of non-opioid analgesics (acetaminophen, nonsteroidal anti-inflammatory drugs [NSAIDs], gabapentinoids, ketamine, lidocaine infusions, regional anesthesia) to reduce opioid requirements while maintaining effective pain control [48].

In acute surgical care, the pharmacist provides specific recommendations: scheduled acetaminophen (maximum 4 grams/day) reduces opioid consumption by 20-30%; NSAIDs (ibuprofen, ketorolac) are effective for bone and soft tissue pain but must be used cautiously in patients with renal impairment or bleeding risk; gabapentin or pregabalin reduces neuropathic pain and opioid requirements but can cause sedation and respiratory depression in the elderly [49]. For patients with severe pain or opioid tolerance (e.g., those on chronic opioid therapy), pharmacists may recommend patient-controlled analgesia (PCA) with programmed limits, or a low-dose ketamine infusion to enhance analgesia and reduce hyperalgesia [50]. The pharmacist also monitors for opioid-induced respiratory depression using capnography or continuous pulse oximetry, and prescribes naloxone standing orders for emergency reversal [56]. A particularly high-risk period is the transition from intravenous to oral opioids. Pharmacists perform opioid stewardship by calculating total daily morphine milligram equivalents (MME), ensuring that discharge prescriptions do not exceed recommended quantities (e.g., no more than 5-7 days' supply for acute pain), and educating patients and families on safe storage, disposal, and recognition of overdose [46]. In institutions where clinical pharmacists participate in discharge medication counseling, the rate of opioid-related emergency department visits within 30 days decreases by nearly 50% [51]. Furthermore, pharmacists can recommend non-pharmacological pain interventions (e.g., ice, positioning, relaxation techniques) and collaborate with physical therapy to reduce pain during mobilization [47].

The integration of pharmacy into the interdisciplinary surgical team requires structural support. The most effective model is attending-level clinical pharmacy services on acute surgical wards and ICUs, with pharmacists present during daily multidisciplinary rounds. Studies from large academic centers show that surgical teams with dedicated rounding pharmacists have lower rates of adverse drug events, shorter time to appropriate antibiotic therapy, higher adherence to VTE prophylaxis guidelines, and reduced hospital costs, with a return on investment ranging from 3:1 to 10:1 [52]. However, many community and rural hospitals lack 24/7 pharmacy coverage, and surgeons may not be accustomed to seeking pharmacist input. Telepharmacy and remote clinical pharmacy services are emerging as solutions to bridge this gap [53]. Several challenges impede optimal pharmacy-led medication safety in acute surgical care. First, workforce shortages of clinical pharmacists, particularly on nights and weekends, mean that many medication errors occur when no pharmacist is available for real-time review [54]. Second, communication gaps between pharmacists and surgeons – for example, a pharmacist's recommendation documented in the chart but not discussed directly – can lead to implementation delays. Structured communication tools such as "pharmacist to surgeon" paging systems or mandatory verbal handoffs for critical recommendations have been shown to improve uptake [55]. Third, electronic health record (EHR) design can either facilitate or hinder pharmacy practice; poorly designed order sets may default to incorrect antibiotic durations, and clinical decision support alerts that fire excessively are often ignored [56].

The future of pharmacy in acute surgical care will be shaped by precision dosing, predictive analytics, and advanced decision support. Pharmacogenomic testing can identify patients who are poor metabolizers of codeine or tramadol (risking toxicity) or who require higher doses of certain antibiotics. Machine learning models that predict postoperative acute kidney injury or opioid-induced respiratory depression can prompt pharmacists to intervene proactively rather than reactively [46]. Automated dispensing cabinets with smart alerts, and "closed-loop" medication administration systems that integrate prescribing, dispensing, and administration into a single EHR-linked workflow, will reduce manual errors [47]. Nevertheless, the core functions of the clinical pharmacist – clinical judgment, communication, and collaboration – will remain human skills that technology augments but cannot replace.

From Surgeon-Centric to Collaborative Leadership: Evolving Team Dynamics

For much of the history of surgery, the operating room and the surgical ward were organized according to a strict hierarchical, surgeon-centric model. The surgeon was viewed as the unequivocal captain of the ship – the sole decision-maker whose authority was rarely questioned, and whose instructions were to be followed without debate by nurses, anesthesiologists, residents, and other team members [57]. While this

model emphasized individual accountability and decisive action, it also created a culture of silence, where junior team members hesitated to speak up about safety concerns, and where communication failures were the norm rather than the exception. Over the past two decades, a growing body of evidence from high-reliability industries (aviation, nuclear power, military) and from healthcare itself has demonstrated that this traditional hierarchy is fundamentally incompatible with safe, high-quality acute surgical care [58]. The modern understanding of team dynamics has shifted toward a collaborative leadership model, where leadership is fluid, shared, and context-dependent; where every team member is empowered to contribute observations and recommendations; and where the goal is not the supremacy of any single discipline but the optimal performance of the team as a whole [59]. This transformation has profound implications for how acute surgical teams are trained, structured, and evaluated, and it lies at the heart of interdisciplinary care.

The limitations of the surgeon-centric model became starkly apparent through landmark studies on surgical errors and communication breakdowns. Analyses of malpractice claims and adverse event reports consistently identified poor teamwork – including failure to share critical information, hierarchical intimidation, and lack of clear role definition – as a contributing factor in more than 70% of serious surgical complications [57]. For example, a junior nurse might notice that the surgical site marking is inconsistent with the planned procedure but feel unable to speak up to a senior surgeon; a circulating nurse might observe that a sponge count is incorrect but be dismissed; an anesthesiologist might recognize that the patient's blood pressure is dropping precipitously but hesitate to interrupt the surgeon during a critical dissection [58]. In each case, the hierarchical structure suppressed the very communication channels needed to prevent harm. The tragic case of wrong-site surgeries, retained foreign bodies, and unrecognized intraoperative complications has been linked directly to a culture where "the surgeon is always right" [60].

The shift toward collaborative leadership has been accelerated by the adoption of team training programs modeled after aviation's Crew Resource Management (CRM). In healthcare, the most widely implemented framework is TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety), developed by the Agency for Healthcare Research and Quality (AHRQ) and the Department of Defense [59]. TeamSTEPPS provides a common language and a set of practical tools for improving teamwork: briefings (preoperative huddles), checklists (such as the WHO Surgical Safety Checklist), structured communication (SBAR – Situation, Background, Assessment, Recommendation), cross-monitoring (team members watching each other's backs), and debriefings (postoperative learning conversations) [61]. The underlying principle is that leadership is not a fixed attribute of the surgeon but a dynamic function that shifts among team members depending on the situation. For example, during a hemorrhage, the surgeon leads the technical aspects of vascular control, but the anesthesiologist leads resuscitation and volume replacement, the nurse leads documentation and supply coordination, and the pharmacist leads anticoagulation reversal [60].

Preoperative briefings (also called "surgical time-outs" or "huddles") are a concrete manifestation of collaborative leadership. Before incision, the entire interdisciplinary team – surgeon, anesthesiologist, nurse, scrub technician, and any other relevant professional – pauses to confirm the patient's identity, the correct surgical site, the planned procedure, the availability of implants or special equipment, and the anticipated critical events. In a surgeon-centric model, this might be a perfunctory, one-way announcement by the surgeon. In a collaborative model, it is a structured, two-way conversation in which each team member is invited to raise concerns [62]. Studies have shown that when briefings are conducted as interactive dialogues rather than monologues, the rate of wrong-site surgery falls to near zero, and team members report higher levels of psychological safety – the belief that it is safe to speak up without fear of humiliation or retaliation [57].

Intraoperative cross-monitoring is another key collaborative behavior. Cross-monitoring means that each team member actively observes the actions of others and provides real-time feedback when something seems amiss. For example, the scrub nurse might note that the surgeon is about to use an instrument that has not been checked for sterility, or the anesthesia provider might notice that the patient's position is

causing excessive pressure on a nerve. In effective teams, cross-monitoring is not seen as criticism but as an essential safety net [58]. Simulation studies have demonstrated that teams trained in cross-monitoring make fewer errors and recover more quickly from unexpected events (e.g., simulated intraoperative fire, sudden hypotension) than teams operating under traditional hierarchy [63].

Debriefings after surgery serve to capture learning and improve future performance. The surgeon-centric model rarely included systematic reflection; the surgeon might simply leave the OR without discussing what went well or what could be improved. In collaborative teams, a short (2-3 minute) debriefing is conducted after the procedure, during which team members share observations: Was there any communication breakdown? Were there equipment issues? Did we adhere to the checklist? Were there any near misses? [59] Debriefings have been shown to reduce the rate of postoperative complications by 30-40% in some studies, particularly when findings are fed back into system improvements (e.g., changing supply locations, updating protocols) [64].

The evolution from surgeon-centric to collaborative leadership also requires changes in surgical education and culture. Historically, surgical residency training emphasized technical prowess, individual decision-making, and authority; teamwork skills were rarely formally taught. Today, accreditation bodies such as the Accreditation Council for Graduate Medical Education (ACGME) require training in interpersonal and communication skills, and many surgical residency programs incorporate simulation-based team training [65]. However, changing the deep-seated attitudes of senior surgeons – many of whom were trained in the old hierarchy – remains a challenge. Interventions such as "leadership walk rounds" where surgeons are observed and given feedback on their teamwork behaviors, and the use of video review of OR team performance, have shown promise [60].

Another critical aspect of collaborative leadership is the empowerment of non-physician team members. Nurses, respiratory therapists, and pharmacists have traditionally been in subordinate positions, expected to defer to physician judgment. In a collaborative model, these professionals are recognized as experts in their own domains, and their input is actively solicited [61]. For example, a respiratory therapist may be the first to detect subtle respiratory deterioration in a postoperative patient and can activate the rapid response team without waiting for a surgeon's order. A pharmacist may identify a dangerous drug interaction and call the surgeon directly to recommend a change. Institutions that have implemented "stop the line" authority – where any team member can halt a procedure if a safety concern is identified – have seen dramatic reductions in preventable harm [62]. This cultural shift is not easy; it requires explicit leadership endorsement, repeated training, and, perhaps most importantly, demonstration that speaking up leads to positive action rather than retribution [66].

The physical environment of care also influences team dynamics. The traditional operating room was designed around the surgeon, with the surgical team arranged in a rigid, hierarchical fashion. Modern "hybrid" ORs and trauma bays are designed with a "circle of safety" concept, where all team members have equal visual access to monitors and the patient, and where communication can flow freely across the circle [57]. The use of whiteboards, digital displays, and shared cognitive aids (e.g., crisis checklists) helps create a common mental model – a shared understanding of the patient's status, the plan, and each member's responsibilities [58].

Despite the clear benefits of collaborative leadership, several barriers persist. First, **professional silos** and interprofessional stereotypes – surgeons who dismiss nurses as "handmaidens," nurses who view surgeons as arrogant, pharmacists who see both as reckless – undermine trust and cooperation [63]. Breaking down these silos requires longitudinal interprofessional education, joint simulation training, and social events that foster personal relationships [64]. Second, workload and time pressure in acute surgical care can cause teams to revert to the default hierarchy; under stress, people tend to fall back on familiar patterns. Regular, brief team huddles and checklists help maintain collaborative behaviors even during crises [65]. Third, variability in team composition – the fact that surgeons, anesthesiologists, nurses, and others often work with different partners each day – makes it difficult to establish stable team dynamics. Standardized

communication protocols and shared mental models are especially important in such fluid environments [57].

Measurement is essential for driving improvement. Tools such as the Observational Teamwork Assessment for Surgery (OTAS) and the Non-Technical Skills for Surgeons (NOTSS) rating system allow teams to assess their collaborative behaviors and track progress over time [58]. Studies using these tools have found that higher teamwork scores are associated with lower complication rates, shorter operative times, and reduced staff turnover [59]. Some hospitals have incorporated teamwork metrics into surgeon and nurse performance evaluations, tying them to professional advancement and compensation [66].

The future of collaborative leadership in acute surgical care is likely to include greater use of artificial intelligence (AI) to analyze team communication patterns. AI algorithms can process audio recordings from the OR to measure speaking turns, interruptions, use of names, and ratio of closed-loop communication (where a message is acknowledged and confirmed). These metrics can provide real-time feedback to teams and identify patterns that predict errors [60]. Another emerging concept is the shared leadership dashboard, where team members can anonymously report concerns about psychological safety or communication breakdowns, triggering targeted interventions [61].

Overcoming Barriers to Effective Interdisciplinary Collaboration in Acute Care

Despite overwhelming evidence that interdisciplinary teamwork improves patient outcomes, reduces complications, and enhances safety in acute surgical care, the widespread and consistent implementation of collaborative models remains elusive in many hospitals worldwide [67]. The gap between what is known about effective teamwork and what occurs at the bedside is not due to a lack of will or evidence; rather, it reflects the presence of deeply entrenched barriers that operate at multiple levels – individual, interpersonal, organizational, and systemic [68]. These barriers include professional hierarchies and stereotypes, poor communication infrastructure, physical separation of team members, variable availability of specialists after hours, lack of shared mental models, inadequate team training, electronic health record (EHR) design flaws, and workload pressures that incentivize efficiency over collaboration [69]. Overcoming these obstacles requires a deliberate, multi-pronged strategy that addresses culture, processes, technology, and leadership. This section synthesizes the most common barriers to effective interdisciplinary collaboration in acute surgical care and presents evidence-based strategies for overcoming them, drawing on implementation science, organizational behavior, and quality improvement research [70].

One of the most pervasive barriers is the persistence of hierarchical culture and professional silos. In many acute surgical settings, the traditional surgeon-centric model remains the default, with junior team members (nurses, respiratory therapists, pharmacists) deferring to senior physicians even when they have legitimate safety concerns [67]. This hierarchy is reinforced by decades of socialization within each profession: medical training emphasizes individual decision-making and authority; nursing training emphasizes obedience and advocacy but often without the structural support to act; pharmacy training focuses on the medication itself rather than team dynamics [71]. The result is a set of professional silos where each discipline operates in parallel rather than together. Overcoming this barrier requires explicit leadership commitment to flattening hierarchy. Successful interventions include: mandating that all team members introduce themselves by name and role at the start of each shift or surgical case; implementing a “two-challenge rule” where any team member can voice a concern twice, and if it is not addressed, they are empowered to escalate to a supervisor; and conducting regular interprofessional simulation training where participants rotate leadership roles [68]. Evidence from the Veterans Health Administration shows that hospitals that implemented structured interprofessional rounding with empowered nursing input reduced adverse events by 32% over two years [72].

A closely related barrier is psychological safety deficits the belief that speaking up with questions, concerns, or mistakes will lead to embarrassment or retribution. In low-psychological-safety environments, team members remain silent even when they recognize a looming error [69]. For example, a junior nurse who notices that the surgical antibiotic prophylaxis was missed may not speak up because previous attempts to

correct senior surgeons were met with anger or dismissal. Studies have shown that psychological safety is the single strongest predictor of team learning and error reduction in healthcare [70]. Overcoming this barrier requires leaders – particularly surgeons and senior nurses – to model vulnerability by admitting their own mistakes, actively soliciting input from junior members, and responding with gratitude rather than defensiveness when concerns are raised [73]. Simple linguistic changes, such as replacing "Why did you do that?" with "Help me understand your thinking," have been shown to increase speaking-up behavior by 40% in simulated settings [67]. Regular "safety huddles" where each team member is asked, "What concerns do you have about today's plan?" and "What do we need to do differently?" can systematically build psychological safety over time [71].

Communication failures are another major barrier, manifesting as incomplete handoffs, missing information during transfers of care, and unclear or disrespectful exchanges between disciplines [68]. The acute surgical patient undergoes multiple handoffs: from emergency department to surgical ward, from ward to OR, from OR to PACU, from PACU to ICU, and between shifts. Each handoff is a potential point of information loss, with studies documenting that up to 60% of critical information is omitted during traditional, unstructured sign-outs [74]. Overcoming this barrier requires the adoption of standardized communication tools such as SBAR (Situation, Background, Assessment, Recommendation), I-PASS (Illness severity, Patient summary, Action list, Situation awareness, Synthesis by receiver), and closed-loop communication (where the receiver repeats back the message to confirm understanding) [69]. These tools must be embedded into the workflow through electronic templates, bedside handoff checklists, and mandatory training. A large multicenter study of postoperative handoffs from OR to ICU found that implementation of a standardized, nurse-led, bedside handoff protocol reduced information omissions from 35% to 8% and decreased preventable adverse events by 30% [75].

Physical separation of team members represents an often-overlooked structural barrier. In many hospitals, the surgical wards are located on a different floor from the pharmacy, radiology is in a separate building, and respiratory therapy equipment is stored in a distant supply closet [70]. This physical fragmentation leads to delays in care and reduces informal communication – the spontaneous, low-friction exchanges that build relationships and catch errors early. Overcoming this barrier requires redesigning the care environment: co-locating clinical pharmacists and respiratory therapists on surgical wards during peak hours; installing dedicated team workrooms adjacent to patient rooms; and using mobile communication devices (e.g., secure texting, Vocera badges) that allow rapid, targeted communication without the need for physical proximity [67]. Some institutions have created "surgical command centers" where real-time patient data, bed tracking, and team availability are displayed on large screens, enabling coordinated decision-making across physically separated team members [72].

Variable availability of specialists after hours (nights, weekends, holidays) is a particularly challenging barrier in acute surgical care. While daytime teams may include a full complement of clinical pharmacists, respiratory therapists, and interventional radiologists, after-hours coverage is often limited to a single "on-call" provider who may be covering multiple hospitals or be available only by phone [68]. This leads to delays in critical interventions – for example, a patient who develops respiratory distress at 2 AM may not have a respiratory therapist available to initiate non-invasive ventilation, or a patient with postoperative bleeding may wait hours for an interventional radiologist to perform embolization [73]. Overcoming this barrier requires system-level investments in 24/7 coverage for key disciplines, particularly in high-volume acute surgical centers. While expensive, cost-effectiveness analyses have shown that the reduction in complications, length of stay, and malpractice claims offsets the added staffing costs [69]. For hospitals with limited resources, telemedicine solutions can provide remote specialist consultation – for example, a tele-respiratory therapist who guides bedside nurses through ventilator adjustments, or a tele-pharmacist who reviews medication orders overnight [74].

Lack of shared mental models – meaning that team members have different understandings of the patient's problems, the care plan, and each other's roles – is a cognitive barrier that undermines coordination [70]. In the acute surgical setting, the surgeon may be focused on technical aspects of the operation, the nurse on

preventing pressure ulcers and falls, the pharmacist on drug interactions, and the respiratory therapist on oxygenation. Without a shared mental model, these professionals work at cross-purposes, duplicating efforts or leaving gaps. Overcoming this barrier requires structured daily interdisciplinary rounds (IDRs) where all team members physically gather at the patient's bedside, review the current status, and create a shared plan for the next 24 hours [75]. IDRs have been shown to reduce length of stay, lower mortality, and improve team satisfaction when they adhere to core principles: all disciplines present, a standardized agenda (e.g., using the "What matters most today?" framework), a designated facilitator (often a senior nurse or pharmacist), and documentation of decisions in a shared communication tool (e.g., a whiteboard or EHR flowsheet) [71].

Inadequate team training is a foundational barrier that perpetuates all the others. Most healthcare professionals receive little to no formal education on teamwork, communication, or leadership during their initial training [67]. As a result, they enter practice with well-developed clinical skills but underdeveloped collaborative skills. Overcoming this barrier requires integrating interprofessional education (IPE) into the curriculum of medical, nursing, pharmacy, and respiratory therapy schools, as well as providing ongoing simulation-based team training for practicing clinicians [76]. The most effective team training programs are not one-time workshops but longitudinal experiences that include didactic instruction, simulation with debriefing, and real-time coaching in the clinical environment [68]. For example, the "TeamSTEPPS" program has been implemented in hundreds of hospitals, with studies showing a 20-30% reduction in surgical complications and a 50% reduction in nurse turnover in institutions that achieved high levels of training penetration [69].

Electronic health record (EHR) design flaws can paradoxically impair rather than enhance interdisciplinary collaboration. Many EHRs are organized around billing and documentation rather than team communication, with separate "tabs" or "views" for each discipline that are not integrated [70]. A surgeon may not see the nurse's daily flow sheet, a pharmacist may not see the respiratory therapist's ventilator settings, and critical information may be buried in lengthy, unstructured progress notes. Overcoming this barrier requires redesigning EHR interfaces to support shared team documentation – for example, a common "team plan" section that is updated daily by the group, or a "handoff summary" that auto-populates with data from all disciplines [72]. Some institutions have implemented "communication orders" that trigger alerts to specific team members when a patient's status changes (e.g., a drop in oxygen saturation notifies the respiratory therapist, an elevated creatinine notifies the pharmacist) [73].

Workload and time pressure are chronic barriers in acute surgical care. When teams are overwhelmed with high patient volumes, frequent emergencies, and staffing shortages, collaborative behaviors such as briefings, debriefings, and cross-monitoring are the first to be abandoned in favor of "getting the work done" [68]. Overcoming this barrier requires a shift from viewing teamwork as an "add-on" to recognizing it as an essential component of efficient care. Time-motion studies have shown that structured interdisciplinary rounds and preoperative briefings actually save time over the course of a day by reducing redundant work, clarifying roles, and preventing errors that require rework [74]. Leaders must protect time for teamwork by adjusting staffing models, reducing non-essential documentation, and explicitly including team coordination in productivity metrics [75].

Finally, lack of accountability and measurement prevents sustained improvement. Many hospitals conduct a one-time teamwork training but do not track whether behaviors have changed or whether outcomes have improved [69]. Overcoming this barrier requires implementing teamwork metrics that are routinely measured and fed back to clinical teams. Validated tools include the Observational Teamwork Assessment for Surgery (OTAS), the Team Climate Inventory (TCI), and the Safety Attitudes Questionnaire (SAQ) [76]. These metrics can be collected through direct observation (e.g., by a trained coach in the OR or on the ward), through anonymous surveys, or through automated analysis of communication patterns (e.g., using AI to measure speaking turns and closed-loop communication from audio recordings) [70]. When these metrics are linked to regular team debriefings and action planning, sustained improvements in collaboration are achievable. For example, a British trauma center that implemented monthly feedback of OTAS scores

to each surgical team saw a 45% improvement in teamwork scores and a 25% reduction in major complications over 18 months [71].

Conclusion

The evolution of acute surgical care from a surgeon-centric, hierarchical model to a collaborative, interdisciplinary framework represents one of the most significant advances in patient safety and quality improvement over the past two decades. This comprehensive review has demonstrated that the contributions of respiratory therapy, nursing, radiology, pharmacy, and surgery are not merely additive but synergistic – the whole team achieves far more than the sum of its individual parts. Respiratory therapists prevent life-threatening pulmonary complications through evidence-based interventions that are most effective when integrated with nursing surveillance and pharmacy-led sedation management. Nursing serves as the indispensable central coordinator, providing continuity across fragmented perioperative handoffs and acting as the final safety net before errors reach the patient. Radiology has transformed acute surgical decision-making by providing rapid, accurate diagnoses and minimally invasive therapeutic alternatives, but only when radiologists are fully integrated into the surgical team through real-time communication and multidisciplinary rounds. Pharmacy leadership in medication safety, antimicrobial stewardship, and multimodal pain management has reduced adverse drug events, surgical site infections, and opioid-related harm, yet these benefits depend on the physical presence of clinical pharmacists during team rounds and handoffs. Finally, the shift to collaborative leadership – where authority is fluid, every voice is heard, and psychological safety is deliberately cultivated – has been shown to reduce wrong-site surgeries, retained foreign bodies, and unrecognized complications, while improving team morale and retention.

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