Postoperative Surveillance Pathways for Anastomotic Leak Through Longitudinal Recovery Assessment

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Abstract

Major gastrointestinal surgery is followed by a period in which physiologic disturbance, treatment response, and recovery expectations remain in flux. During that interval, clinicians must decide whether new findings represent ordinary postoperative adaptation or the early expression of a serious complication. Anastomotic leak is especially difficult to identify because it often becomes visible gradually rather than at a single obvious moment. The relevant signs are commonly dispersed across bedside observations, laboratory changes, drain findings, imaging decisions, and altered recovery patterns. This paper examines anastomotic leak as a postoperative surveillance problem rather than as a question of preoperative risk alone. The proposed perspective treats recognition as a continuing process of interpretation that unfolds across care settings, time points, and professional roles. It emphasizes that the most useful clinical information often arises after the operation, when the trajectory of recovery begins to diverge from what would otherwise be expected. The paper develops a framework organized around longitudinal recovery assessment, staged escalation, communication between teams, digital support tools, and continuity beyond the initial hospital stay. Particular attention is given to the difference between isolated abnormalities and persistent patterns, to the interaction between clinical suspicion and testing intensity, and to the need for surveillance systems that remain workable in routine practice. The discussion argues that postoperative monitoring should be understood as an active interpretive pathway in which baseline risk informs attention, but evolving postoperative evidence governs action. In that formulation, the central objective is not merely to predict which patients might leak, but to recognize departure from uncomplicated recovery early enough to support timely investigation and treatment.

1 Introduction

Anastomotic leak continues to occupy a difficult place in postoperative care because it does not usually announce itself through one decisive observation [1]. The complication may be biologically underway before it is clinically visible, and the clinical picture that eventually emerges is often assembled from several pieces of evidence that appear at different times and in different settings. A patient may have a mildly persistent tachycardia, a delay in bowel function, a laboratory pattern that seems a little more inflammatory than expected, or an abdominal examination that is not clearly alarming but no longer comfortably reassuring. None of these findings alone is sufficient to define a leak, yet their combined persistence can alter the meaning of the recovery trajectory. The interpretive burden falls on the postoperative team, which must distinguish ordinary postoperative disturbance from early structural failure while resources, monitoring intensity, and therapeutic thresholds vary across units and over time.

This difficulty exposes a mismatch in how the problem is often framed. Much of the predictive literature has emphasized preoperative or perioperative risk estimation. That work has value. It may assist with patient counseling, operative planning, diversion decisions, and the identification of patients who merit closer attention after surgery. Even so, the most urgent question after an anastomosis has been constructed is usually not whether the patient was high risk before the procedure. The urgent question is whether the patient now appears to be recovering as expected or whether the course is beginning to separate from the expected pattern in a way that warrants renewed scrutiny. That is a different problem [2]. It is not primarily about baseline probability. It is about ongoing postoperative interpretation.

The distinction matters because postoperative care is intrinsically sequential. New information accumulates across hours and days. A laboratory abnormality may matter less for its absolute value than for whether it is resolving, persisting, or worsening. A fever may be less informative than the combination of fever, ileus, rising inflammatory markers, and an unexpectedly difficult return to oral intake. Drain output may be more useful when understood in relation to the operative anatomy, the timing since surgery, and other signs of recovery failure. Clinicians rarely reason from one data point in isolation. They reason from patterns. They revise concern repeatedly as the patient moves through early stabilization, ward recovery, mobilization, dietary advancement, discharge preparation, and sometimes readmission. A static formulation of risk does not map cleanly onto that lived clinical process.

Postoperative surveillance offers a more coherent frame because it takes this temporal structure seriously [3]. Surveillance is not simply repeated prediction in a generic sense. It is an organized method of observing recovery, detecting departure from an expected course, deciding when that departure becomes significant, and determining what level of escalation is justified at each stage. It relies on repeated bedside assessment, on contextual interpretation of tests, on awareness of how routine postoperative findings should evolve, and on coordination across clinicians who do not all encounter the same patient information at the same time. In practice, surveillance is already happening informally in every surgical service. The problem is that it is often fragmented. Important signals may be distributed across nursing notes, laboratory trends, procedural memories, handover conversations, and unstructured concern. When surveillance remains implicit, recognition can be delayed not because the evidence was absent, but because it was not integrated early enough.

A broader surveillance perspective also changes how technology should be understood. Digital systems are often imagined as devices that provide a risk score or warning signal, but their real usefulness depends on whether they can support the workflow through which concern becomes action. A score that does not align with rounds, handoffs, escalation pathways, or imaging access may have limited impact even if it appears statistically impressive. By contrast, a simpler monitoring aid that draws attention to trajectory change at the right time may be more clinically meaningful. For postoperative leak, the relevant design question is not only how to estimate who will leak [4]. It is how to support recognition in the interval when the trajectory is still ambiguous but increasingly inconsistent with uncomplicated recovery.

This paper develops that argument in a deliberately practical way. Rather than centering preoperative stratification or mathematical optimization, it focuses on the postoperative recovery pathway itself. The following sections examine how leak recognition changes when the central unit of analysis becomes the evolving recovery narrative rather than the single baseline patient profile. The discussion moves from early postoperative interpretation to later ward surveillance, from care-setting differences to escalation thresholds, from digital support to data limitations, and from inpatient monitoring to postdischarge continuity. The aim is not to dismiss preoperative assessment, but to show that it is only one layer within a broader surveillance architecture. Once an anastomosis exists, what matters most is how recovery unfolds, how deviations are noticed, and how teams respond when concern shifts from vague unease to actionable suspicion.

2 From Risk Stratification to Recovery Surveillance

Preoperative risk stratification has an understandable appeal because it promises clarity at a time when major decisions are still open. Before surgery, clinicians may estimate the likelihood of complications from age, comorbidity, nutritional condition, disease burden, urgency, operative history, and planned procedure. These estimates can influence whether a patient undergoes diversion, whether optimization is pursued more aggressively, whether monitoring is intensified after surgery, or whether the patient and family are counseled differently. Yet the strength of preoperative risk estimation also reveals its limitation. It deals with what is knowable before the postoperative trajectory begins [5]. Anastomotic leak, however, becomes clinically relevant through what happens after the operation, not merely through what was true beforehand.

A surveillance-oriented view starts from a different clinical observation. Once surgery is complete, the patient enters a changing recovery environment in which expectations are time dependent. Hemodynamic fluctuations may be unsurprising in the immediate postoperative period. Pain, ileus, and inflammatory responses are common. Laboratory values may initially worsen before improving. Mobilization can be delayed for reasons unrelated to leak. What matters is therefore not just whether a value is abnormal, but whether it fits the expected stage of recovery for that specific patient and procedure. A patient recovering uneventfully after a relatively difficult operation may still carry more baseline risk than another patient, yet the former may look reassuring on postoperative day two while the latter may look subtly wrong. The recovery course begins to outweigh the baseline profile because it contains more direct information about what the anastomosis is actually doing.

This is why surveillance is best understood as the continuous interpretation of deviation from expected recovery. The relevant comparator is not a universal postoperative template [6]. It is a context-sensitive expectation shaped by operative details, care setting, and patient-specific recovery potential. A diverting stoma may alter the signs

through which leak becomes visible. A pelvic dissection may produce postoperative discomfort and inflammatory response that complicate interpretation. Intensive care recovery generates denser information than ward recovery. Enhanced recovery protocols can make deviations more noticeable because return of function is expected to occur sooner. Surveillance must therefore be individualized without becoming idiosyncratic. It needs enough structure to distinguish concerning persistence from ordinary variation, but enough flexibility to recognize that recovery does not look the same in every patient.

Thinking in terms of surveillance rather than static prediction also helps separate two related but different clinical purposes. The first purpose is to identify who merits closer postoperative attention from the outset. The second is to determine, during recovery, who now requires escalation because the course has become suspicious. The first purpose can be served reasonably well by baseline and intraoperative information [7]. The second depends much more heavily on postoperative developments. Confusion arises when the first purpose is treated as though it automatically solves the second. A patient identified as high risk before surgery does not necessarily need urgent investigation afterward if the recovery is smooth. Conversely, a patient not labeled high risk preoperatively may still require early intervention if the recovery pattern becomes inconsistent with what had been expected. Surveillance keeps these purposes distinct while allowing them to inform one another.

Table 1: Key Dimensions of Postoperative Surveillance

Dimension	Focus	Data Type	Clinical Role
Trajectory	Change over time	Trends	Detect deviation
Context	Procedure-specific norms	Narrative + metrics	Interpret findings
Persistence	Duration of abnormalities	Serial labs/vitals	Escalation trigger
Integration	Multi-source synthesis	Notes + tests	Build clinical picture

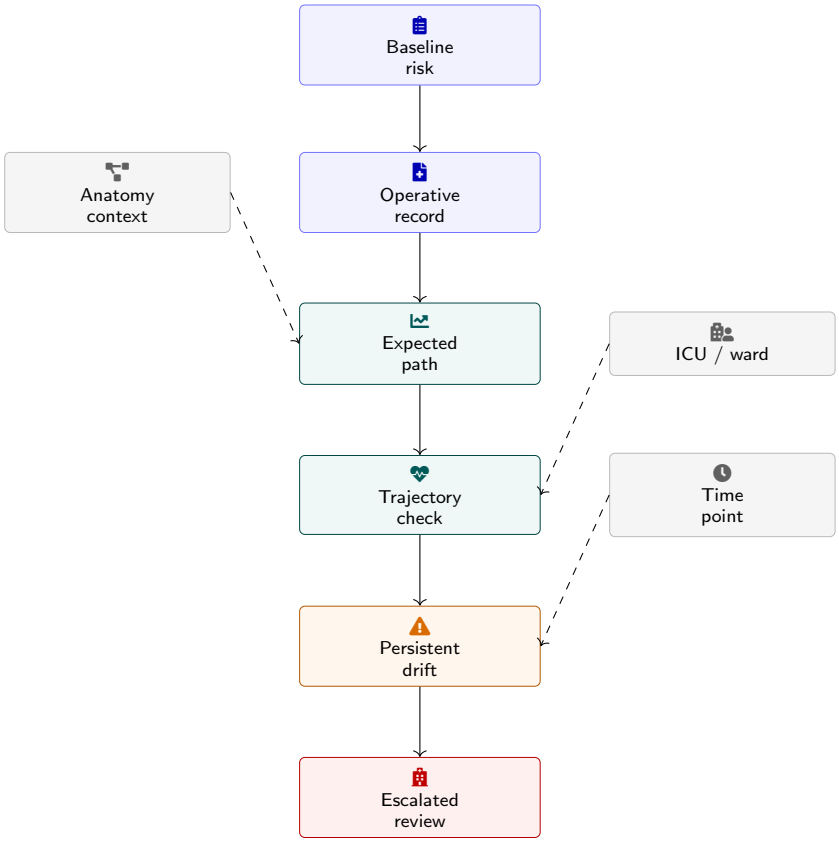

Figure 1: Baseline risk and operative knowledge shape attention, but postoperative surveillance becomes decisive once the recovery path is compared with what should be happening at that stage. The key transition is from static predisposition to longitudinal interpretation of trajectory drift.

Another advantage of the surveillance frame is that it encourages attention to timing rather than only presence or absence of findings. In ordinary documentation, events such as fever, tachycardia, leukocytosis, ileus, and pain are often listed as if they have stable meaning throughout admission. In reality their significance changes rapidly. A fever on the evening of surgery may be interpreted differently from the same fever on postoperative day four. A modest leukocytosis immediately after operation is common, whereas persistent or rising inflammatory markers

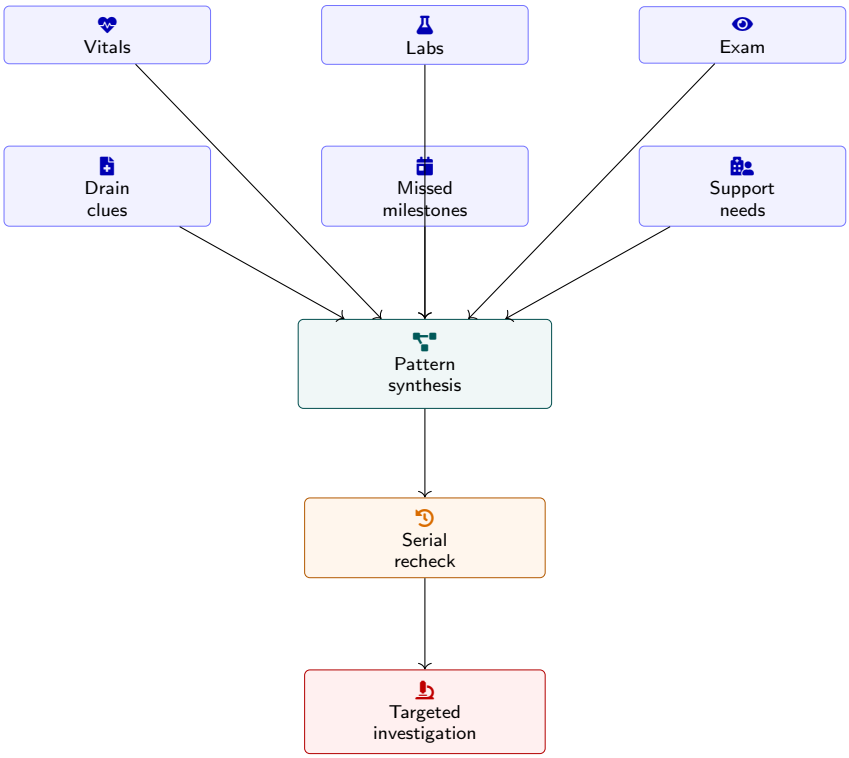

Figure 2: Early postoperative interpretation is a synthesis problem rather than a single-threshold problem. Bedside signs, inflammatory change, drain findings, missed recovery milestones, and support intensity become meaningful when they persist together and are rechecked serially.

Table 2: Comparison of Risk Stratification and Surveillance

Aspect	Risk Stratification	Surveillance	Implication
Timing	Preoperative	Postoperative	Dynamic focus
Data	Baseline variables	Evolving data	Real-time insight
Output	Probability	Trajectory deviation	Action guidance
Goal	Anticipation	Recognition	Earlier intervention

after the period of expected early disturbance may shift the interpretation of the entire trajectory. Surveillance asks not only what is present, but when it appears, whether it resolves, and what other expected milestones fail to occur alongside it. This temporal sensitivity is difficult to capture through one-time prediction but central to bedside recognition [8].

The shift from risk stratification to surveillance also modifies how success should be judged. A preoperative score is usually evaluated by its ability to discriminate patients who will and will not eventually experience a complication. A surveillance pathway should be judged by whether it helps detect meaningful departure from uncomplicated recovery early enough to matter. This brings attention to lead time, false reassurance, false alarm burden, clarity of escalation, and usability in ordinary care. A system that identifies a patient as high risk before surgery may still contribute little if it does not help anyone decide when to image, when to intensify review, or when to intervene. Surveillance is more demanding because it lives closer to action. Its outputs are not merely descriptive. They alter observation, testing, and treatment decisions.

This perspective does not render baseline information irrelevant. On the contrary, preoperative and intraoperative knowledge can make surveillance more efficient by shaping attention and lowering the threshold for concern in selected circumstances. The point is that baseline information should guide how closely clinicians watch the recovery, not determine the final interpretation in advance. Once the patient is in the postoperative period, the trajectory becomes the main text and the baseline profile becomes part of the context [9]. That inversion is important. It means the clinical question is not simply who is vulnerable, but who is declaring vulnerability through the unfolding recovery course. In that sense, postoperative surveillance is not a secondary refinement of preoperative prediction. It is a different clinical task and, for leak recognition after surgery, the more decisive one.

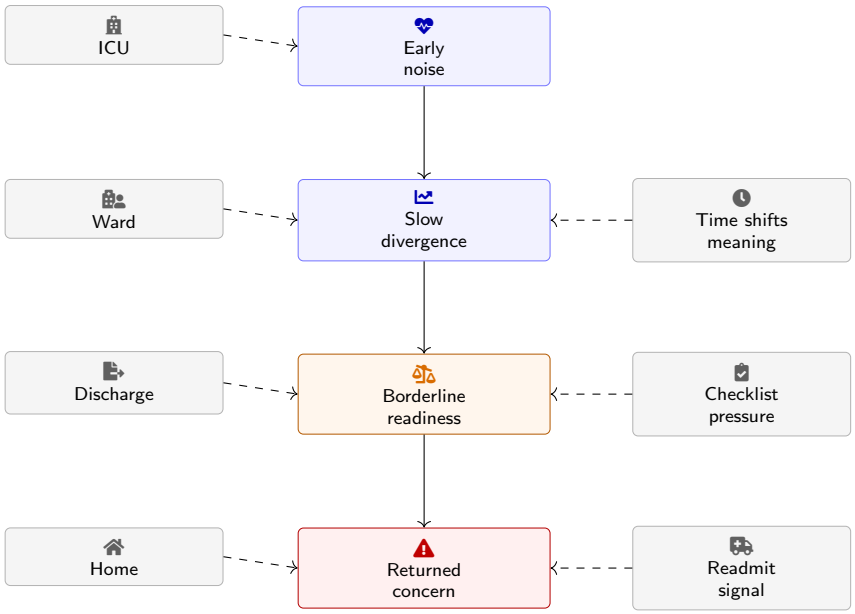

Figure 3: Beyond the first 48 hours, the problem often becomes one of persistent inconsistency rather than dramatic collapse. Monitoring density falls across settings, while discharge momentum and thinner data can make slowly worsening recovery harder to interpret.

Table 3: Early Postoperative Indicators and Interpretation

Indicator	Early Meaning	Concerning Pattern	Action
Fever	Common response	Persistent/rising	Reassess
Tachycardia	Pain/volume	Unexplained trend	Monitor closely
Leukocytosis	Inflammation	Non-resolving	Repeat labs
Ileus	Expected delay	Prolonged course	Evaluate cause

3 Interpreting the Early Postoperative Course

The first postoperative days are often the most diagnostically confusing because they combine high physiologic noise with high clinical consequence. Surgery itself generates inflammation, fluid shifts, pain, stress responses, transient organ dysfunction, and alterations in routine bodily function. Many of the signs that later contribute to suspicion of leak can also occur in patients who recover uneventfully. Fever may accompany atelectasis or generalized postoperative inflammation. Tachycardia may reflect pain, hypovolemia, anxiety, bleeding, or simple exertion. Delayed bowel function may follow opioid use, extensive bowel handling, or a difficult pelvic dissection. Laboratory changes may reflect expected tissue stress rather than infection or structural failure. The task in early surveillance is therefore not to overinterpret every abnormality, but to identify when ordinary postoperative disorder begins to organize into a pattern that no longer fits the anticipated course [10].

This process depends heavily on serial interpretation. Isolated values matter less than persistence and combination. A white blood cell count that is modestly elevated once may be unremarkable. The same count that remains elevated, or rises, while the patient continues to require increasing support or fails to mobilize as expected carries different weight. Likewise, a mildly elevated lactate is not automatically diagnostic of leak, but nonresolution of metabolic stress despite treatment deserves closer consideration. The same principle applies to bedside findings. A vague abdominal tenderness may have limited meaning shortly after surgery, while an evolving abdominal examination accompanied by delayed diet tolerance, systemic inflammatory signs, and an uneasy overall appearance may indicate something more consequential than postoperative discomfort. Early surveillance is therefore less about collecting isolated red flags than about observing whether expected improvement is occurring.

One of the most important and often underappreciated aspects of early monitoring is the role of negative milestones. Recovery is not judged only by what worsens. It is judged by what fails to improve. A patient who should be mobilizing but remains unusually inactive, who should be tolerating intake but does not, or who should be progressing toward transfer or discharge but instead appears stuck may be declaring complication indirectly [11]. Leak may not present first as a dramatic positive finding. It may present as a pattern of stalled recovery that becomes harder to explain as time passes. This is why surveillance requires a clear sense of what ordinary recovery should look like after each type of operation. Without that expectation, clinicians can normalize delay until the

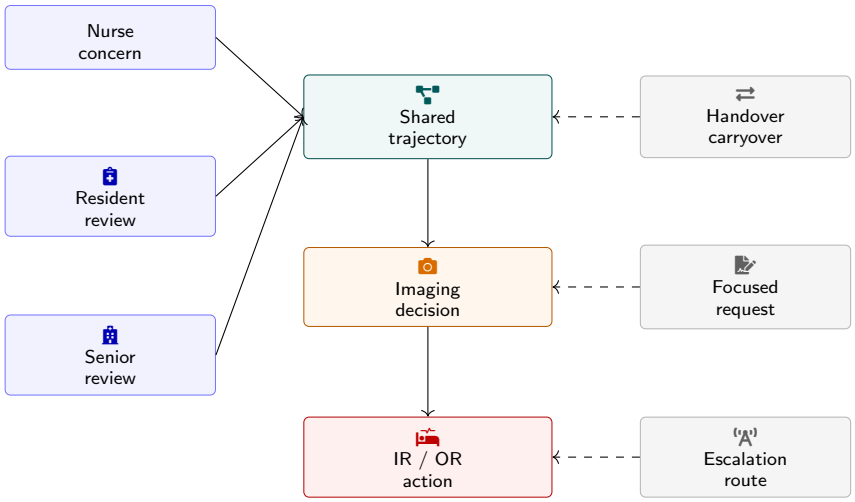

Figure 4: Leak surveillance becomes operational when scattered observations are converted into a shared longitudinal account and then routed through graded escalation. The pathway is safer when concern survives handover and when imaging or intervention requests are framed by the evolving clinical story.

Table 4: Negative Recovery Milestones

Milestone	Expected Course	Concerning Absence
Mobilization	Early ambulation	Persistent inactivity
Diet tolerance	Gradual intake	Ongoing intolerance
Bowel function	Return by days 2–4	Continued ileus
Inflammation	Downtrend	Plateau or rise

complication becomes more explicit and therefore later.

The early postoperative period also exposes the importance of bedside synthesis. Digital systems and laboratory trends are helpful, but much of the first suspicion of leak remains experiential. Nursing staff often detect that the patient appears wrong before any single metric crosses a formal threshold. Surgeons may recognize that the recovery feels discordant with the operative course. Residents may notice a subtle mismatch between the chart and the bedside state. These forms of judgment are difficult to standardize, yet they are central to surveillance because they frequently prompt repeat assessment, earlier testing, or broader discussion. A robust surveillance pathway should not marginalize such impressions [12]. It should create a structure in which they can be documented, communicated, and revisited rather than left as unspoken intuition.

Drain findings illustrate the same interpretive complexity. The value of drain information depends on the operation performed, the anatomy involved, and the expected character of output over time. A drain may provide early clues, but it can also mislead if interpreted without context. Small changes in appearance or volume are not always significant, and absence of dramatic drain abnormalities does not exclude leak. What matters is whether drain findings fit the broader recovery narrative. Concerning output that appears alongside inflammatory persistence, pain escalation, or delayed recovery deserves different attention than similar output in an otherwise reassuring patient. Surveillance thus requires integration rather than single-channel thinking. No sign can be interpreted fully without the company it keeps.

Another challenge in early postoperative interpretation is that treatment can temporarily blur clinical meaning. Resuscitation may improve perfusion markers without correcting the underlying defect. Analgesia may suppress overt signs of distress [13]. Antibiotics may alter inflammatory trajectories. A patient transferred to a higher-acuity unit may appear better monitored rather than simply worse. These dynamics do not invalidate surveillance, but they make it more dependent on trend and response. Improvement that occurs only under significant support may not be as reassuring as spontaneous normalization. Likewise, clinical stability that disappears once support is reduced may reveal that the underlying problem remains unresolved. Early surveillance therefore has to follow not only the patient's apparent state, but the effort required to maintain that state.

The danger in the early period lies at both extremes. One danger is complacency, where normal postoperative complexity is used to explain away a developing leak until the evidence becomes unmistakable and therefore later. The other danger is indiscriminate alarm, where every transient abnormality drives unnecessary imaging, repeated interruptions, and erosion of trust in monitoring systems. Effective surveillance sits between these extremes. It

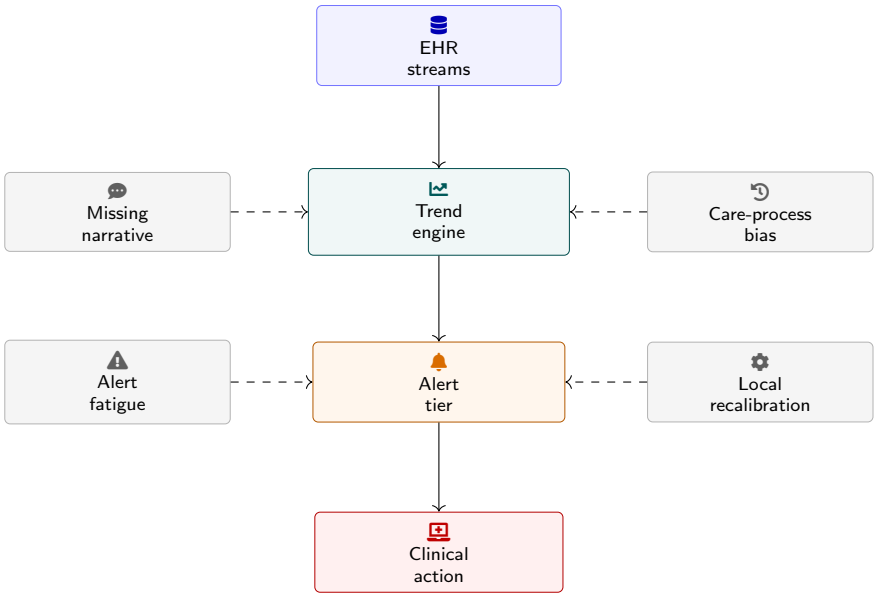

Figure 5: Digital support is strongest when it organizes trajectories rather than merely reproducing isolated abnormalities. Governance remains essential because record data also encode clinician behavior, and useful deployment depends on interpretability, alert burden, and local recalibration.

Table 5: Care Setting Differences in Surveillance

Setting	Data Density	Strength	Limitation
ICU	High	Continuous monitoring	Noise
Ward	Moderate	Bedside continuity	Sparse metrics
Outpatient	Low	Symptom insight	Delayed detection
Step-down	Intermediate	Transition care	Fragmentation

treats early postoperative disorder as expected but not uninterpretable. It recognizes that the meaning of a sign depends on its persistence, context, and relationship to expected milestones [14]. It values repeat review when the trajectory feels uncertain rather than demanding certainty before concern is voiced. Most importantly, it shifts the focus from whether one sign is severe enough to whether the overall recovery story is becoming less plausible as ordinary convalescence. That change in narrative coherence is often the first real sign that surveillance should intensify.

4 Surveillance Beyond the First Forty-Eight Hours

Although early postoperative monitoring receives much attention, leak recognition often becomes more challenging after the first intense phase of hospital recovery. As patients leave the immediate postoperative period, monitoring frequency usually decreases, the number of clinicians reviewing the case may narrow, and the expectation of improvement becomes stronger. At the same time, some leaks evolve more gradually and may become more visible only when the patient transitions to a lower-intensity environment. This later phase is important because it can produce a false sense of security. The absence of dramatic early deterioration may be mistaken for resolution of risk, even though the complication may only be becoming more legible as the initial physiologic noise subsides.

Later surveillance depends increasingly on recognizing inconsistency rather than acute instability. The patient may not be overtly septic or severely unstable, yet the recovery may continue to drift off course. Oral intake remains poor without a clear explanation. Bowel function does not return as expected [15]. Low-grade fever lingers. Inflammatory markers fail to normalize. The patient appears fatigued, uncomfortable, or not ready for the level of independence that discharge planning assumes. These signs can be easy to discount because each one is common and often nonspecific. What matters is their persistence and combination. As the postoperative days pass, explanations that seemed reasonable early on may lose credibility. Surveillance after the first forty-eight hours is therefore less about dramatic alarms and more about the disciplined recognition that time itself changes the meaning of modest abnormalities.

Ward-based recovery creates particular vulnerability because data are thinner than in high-acuity settings. Measurements are less frequent, physiologic monitoring is less continuous, and clinician review can become more

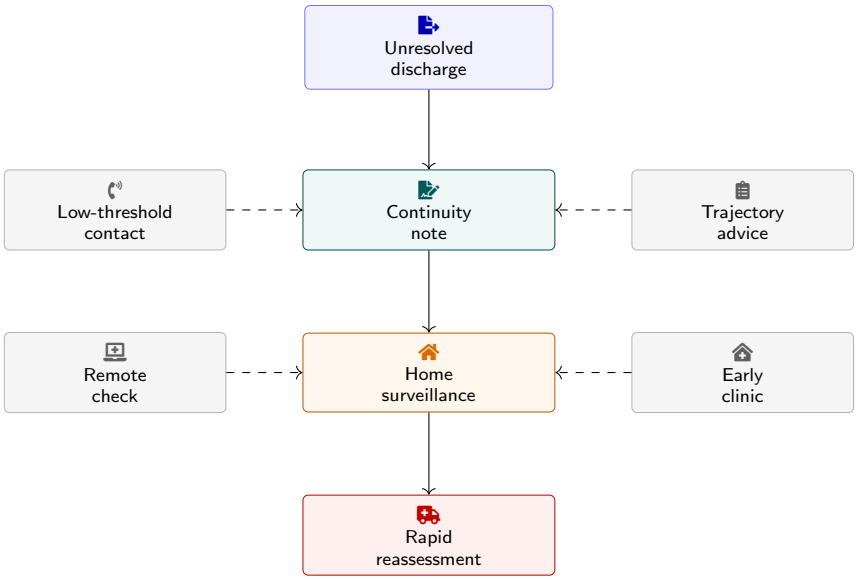

Figure 6: Postdischarge safety depends on carrying unresolved concern forward rather than treating discharge as the endpoint of surveillance. Structured continuity notes, trajectory-based patient guidance, early contact channels, and rapid reassessment options help preserve the clinical story across settings.

Table 6: Escalation Pathway in Suspected Leak

Level	Trigger	Action	Goal
Low	Mild concern	Repeat review	Clarify trend
Moderate	Persistent deviation	Labs/imaging	Identify cause
High	Strong suspicion	Intervention	Source control
Critical	Instability	Urgent surgery	Stabilization

episodic. In this environment, small signals may be missed or interpreted in isolation. The nursing assessment becomes especially important because it provides continuity that intermittent physician review may lack. Changes in demeanor, appetite, willingness to mobilize, sleep pattern, or generalized appearance can become meaningful before laboratory or imaging evidence becomes definitive [16]. Later surveillance should therefore not depend entirely on numerical thresholds. It should preserve structured space for narrative bedside concern, especially when several small deviations are converging without a dominant explanation.

Discharge planning adds another layer of complexity. Hospitals are under pressure to reduce unnecessary length of stay, and enhanced recovery pathways appropriately encourage earlier mobilization and discharge when patients meet defined criteria. Yet accelerated discharge can narrow the window during which evolving complications are observed directly by the surgical team. A patient who seems nearly ready for discharge may still be in the early stages of a leak-compatible trajectory that has not fully declared itself. This does not mean discharge should be delayed indiscriminately. It means discharge decisions should include attention to trajectory quality, not only to checklist completion. A patient whose numbers are acceptable but whose course feels persistently discordant may deserve one more cycle of review, repeated testing, or more explicit postdischarge follow-up than a patient whose recovery narrative is coherent.

Readmission patterns reveal the same issue from the opposite direction. Some leaks are recognized only after patients leave the hospital and return with pain, fever, intolerance of intake, or sepsis. When this happens, the question is often whether there were earlier signs that did not seem strong enough at the time or whether surveillance failed to extend meaningfully beyond discharge [17]. In many cases, the problem is not a complete absence of warning but a failure of continuity. Small inpatient concerns do not always translate into clear outpatient instructions, rapid access review, or low-threshold reassessment pathways. Later surveillance must therefore be thought of as a bridge, not just an inpatient responsibility. If the risk of complication remains clinically relevant after discharge, then the surveillance system cannot simply end at the hospital door.

The later postoperative phase also demands caution with normalization. Once a patient looks better than they did initially, teams can become inclined to interpret residual abnormalities as part of slow but acceptable recovery. This may be true, but it can also obscure the significance of persistent deviation. A patient who is less unwell than yesterday may still be insufficiently well for their postoperative stage. Surveillance requires attention to absolute

Table 7: Digital Surveillance Strengths and Limits

Feature	Advantage	Limitation	Requirement
Trend aggregation	Pattern detection	Data bias	Context use
Alerts	Early warning	Fatigue risk	Calibration
Scoring	Risk ranking	Interpretability	Clear thresholds
Integration	Workflow support	Variability	Local adaptation

Table 8: Postdischarge Surveillance Components

Component	Method	Purpose	Risk if Absent
Instructions	Symptom + trajectory	Guide patients	Missed signals
Follow-up	Early review	Reassess course	Delayed care
Communication	Detailed summary	Continuity	Fragmentation
Remote monitoring	Digital check-ins	Extend observation	Data overload

recovery milestones as well as to improvement. A descending temperature or white cell count may reassure, but if the patient remains unable to progress in diet, mobility, or bowel function, the overall picture may still justify concern. This is particularly important in leaks that evolve with partial containment or intermittent symptom burden, where dramatic collapse may never occur until the complication is advanced [18].

There is also a communication risk in later surveillance. Early postoperative care often involves frequent team discussion, while later recovery may become more diffuse, with shorter reviews and greater reliance on assumptions that the trajectory is broadly favorable. When concern is modest but persistent, it can disappear in handovers because no single moment seems decisive enough to frame as urgent. This is one reason why structured surveillance language can be helpful. Phrases such as not yet on expected recovery path, unresolved inflammatory picture, or delayed return to anticipated function may sound simple, but they help convert vague unease into shareable clinical meaning. Later surveillance benefits when low-grade concern is made visible rather than left to individual memory. The complication often becomes dangerous not because nobody noticed anything, but because no one made the small abnormalities part of a clear longitudinal story.

5 Care Setting, Team Communication, and Escalation

Postoperative surveillance does not occur in a single clinical environment. The meaning of findings changes across intensive care units, step-down units, surgical wards, and outpatient follow-up, and so does the process through which concern is communicated. Intensive care settings generate dense physiologic data, frequent review, and a lower threshold for intervention. Wards generate sparser quantitative information but often more continuous bedside familiarity. Outpatient surveillance relies on symptom reporting, planned review, and the ability of patients and families to recognize when recovery feels wrong [19]. A coherent surveillance pathway must therefore bridge different informational cultures rather than assume that one type of monitoring fits every stage of recovery.

The intensive care unit offers both advantages and disadvantages for leak surveillance. The advantage is obvious: measurements are frequent, hemodynamics are visible, organ support is carefully documented, and deterioration is likely to be noticed quickly. The disadvantage is interpretive noise. Many ICU patients have reasons to be physiologically abnormal that are not specific to leak, including fluid shifts, respiratory complications, cardiovascular instability, or complex responses to major surgery itself. In this setting, leak surveillance benefits from trend interpretation and from close linkage to operative knowledge. The team must ask not only whether the patient is unstable, but whether the pattern and direction of instability fit what should have happened after this particular operation. Dense data are useful, but without contextual framing they can become overwhelming rather than clarifying.

The ward poses a different challenge. Here the problem is usually not too much data but too little integrated attention. Measurements are intermittent, staffing patterns differ, and the patient may be judged mainly by whether discharge milestones are being met. Surveillance on the ward often depends heavily on pattern recognition by nurses, trainees, and teams that may each hold partial pieces of the story [20]. Communication becomes crucial. If the night team notices persistent tachycardia, the day team sees poor intake, and nursing staff sense that the patient looks increasingly uncomfortable, those observations need to accumulate rather than reset at each transition. A surveillance pathway fails when each shift interprets the patient afresh without inheriting the unresolved concerns of the previous one.

This makes handover structure important. Routine handovers often prioritize dramatic events, procedures, and immediate tasks. Less dramatic but persistent concerns may be omitted because they do not sound urgent enough to command attention. Yet leak surveillance often depends precisely on these accumulating concerns. A

patient who is not crashing but is not progressing should be represented clearly in handover language. It is useful when teams communicate not only what happened, but what narrative remains unresolved. Statements such as recovery slower than expected without clear cause, inflammatory markers not following anticipated trend, or needs reassessment if no improvement by next review create continuity of concern. They make the surveillance process longitudinal rather than episodic.

Escalation thresholds are another area where communication and surveillance intersect [21]. Concern about leak rarely jumps directly from routine care to reoperation. More often it progresses through levels. A bedside review may lead to repeated laboratory testing. A laboratory pattern may lead to senior review. Senior review may prompt imaging or transfer to a higher-acuity setting. Imaging may trigger interventional drainage or operative exploration. These steps should not be understood as simple yes-or-no decisions. They are part of a graded escalation pathway in which the costs of false alarm and delayed detection differ. Monitoring becomes safer and more consistent when teams share a mental model of what each level of concern should trigger. Without that model, escalation can become arbitrary, depending more on individual caution or local custom than on the actual trajectory of the patient.

Communication with radiology and other consulting services also matters. Imaging is often central to leak evaluation, yet the usefulness of imaging depends heavily on the quality of the clinical question [22]. A vague request to rule out leak may be less informative than a focused explanation of the recovery deviation, operative anatomy, timing, and specific concern. Surveillance is strengthened when the evolving narrative is communicated clearly to those who provide downstream diagnostic interpretation. The same applies to interventional and intensive care teams. A well-framed account of trajectory change can help align the entire response pathway, whereas fragmented information may delay consensus even when concern is already substantial.

One of the more subtle roles of communication is in legitimizing uncertainty. Teams are sometimes reluctant to escalate concern without a firm positive finding, especially when earlier tests have been inconclusive or when the patient appears only moderately unwell. Yet leak surveillance often requires acting during uncertainty, not after it has resolved. It should be acceptable within the culture of care to say that the trajectory is not convincing, that the patient is not on the expected path, or that repeated reassessment is warranted because the explanation remains incomplete. A surveillance system rooted in escalation rather than static categorization helps normalize this. It frames concern as a legitimate evolving state, not a failure to reach certainty quickly.

Digital support can assist, but it cannot replace communicative discipline [23]. Alerts or trend displays may highlight that a patient is deviating from expected recovery, yet a meaningful response still depends on whether clinicians know how to discuss and act on that deviation. If escalation routes are unclear, digital signals may simply add another layer of noise. By contrast, even relatively simple tracking of unresolved postoperative concerns can improve surveillance when it is tied to defined communication moments such as handovers, rounds, escalation calls, and discharge planning. The central issue is not whether concern exists. It is whether concern travels with the patient as they move through different teams and settings. In leak recognition, delays often reflect failure of shared longitudinal understanding as much as failure of measurement.

6 Digital Support, Data Limits, and Practical Governance

Digital tools hold clear promise for postoperative leak surveillance because they can assemble information that is otherwise spread across the record. Laboratory trends, vital signs, care-setting changes, procedure timing, and note-derived clues can be brought into one view more reliably than busy clinicians can do manually for every patient at every moment. Used well, such tools can help make longitudinal pattern recognition less dependent on memory and chance. They may highlight persistence where individual teams perceive only isolated abnormalities. They may identify patients whose trajectories are subtly but consistently diverging from expectations. They can also support standardized review by ensuring that the same surveillance inputs are visible to different members of the team [24].

Even so, digital support should be approached with caution because postoperative data are not neutral reflections of patient physiology. They are shaped by care processes. A patient who worries clinicians will often have more laboratory tests, more bedside assessments, and more imaging. Another patient may have sparse data precisely because no one has yet become concerned. This means that the record contains both the patient's condition and the hospital's reaction to that condition. A digital system may therefore become good at identifying where clinicians are already focusing attention rather than where leak biology is first becoming visible. That is not useless, but it is different from early surveillance. Good governance requires understanding whether a tool is detecting physiologic deviation, reproducing human suspicion, or some combination of both.

A related issue is calibration to action. A monitoring system is not helpful merely because it assigns higher scores to patients who later prove to have leaks. What matters is whether its outputs can be interpreted at the thresholds where decisions occur. If a digital warning is used to prompt repeat review, then a modest false-positive burden may be acceptable [25]. If the same warning is treated as a trigger for aggressive imaging or invasive

workup, the burden becomes much more consequential. This is why digital surveillance should not be evaluated only by broad statistical discrimination. The practical question is what a given level of concern is meant to trigger and whether the system remains reliable at that level. In one electronic health record analysis of colorectal surgery admissions, postoperative white blood cell count, ICU admission status, and postoperative lactate emerged as strong contributors to prediction, while the findings also suggested that clinically useful implementation would depend heavily on postoperative monitoring design and acceptable false alarm tradeoffs rather than on preoperative scoring alone, as discussed by Sadanandan (2024) [26].

That point is especially important because the apparent sophistication of a model can create false reassurance. A complex algorithm may appear to outperform simpler approaches, yet still be poorly suited to real clinical work if it fluctuates too often, is difficult to explain, or relies on variables that mainly reflect local documentation habits. By contrast, a more modest tool may prove more useful if it aligns with rounds, handovers, and escalation pathways. Practical governance therefore includes attention to interpretability, not as an abstract virtue, but as a condition of adoption. Clinicians need to understand why concern is rising. Is it due to persistent inflammatory nonresolution, increasing support needs, repeated reassessment by the team, or a cluster of several modest signals? A tool that cannot answer that question will struggle to become part of ordinary surveillance culture.

Data quality poses further limits. Electronic records contain omissions, timing inconsistencies, and unstructured nuances that are difficult to capture [27]. Some important elements of leak suspicion remain narrative, such as how the abdomen feels, how the patient looks at the bedside, or how recovery compares with the surgeon's expectation after a technically challenging operation. If a digital system is built as though all relevant information is equally visible and equally reliable in the structured record, it will necessarily misrepresent parts of the clinical process. Governance therefore involves knowing what the tool cannot see and ensuring that clinicians are not encouraged to treat its outputs as comprehensive. The most defensible role for digital surveillance is assistive rather than authoritative. It should sharpen attention and organize information, not replace clinical synthesis.

Another governance issue concerns alert fatigue. If a system repeatedly draws attention to patients whose abnormal findings are already obvious or clinically explained, teams may begin ignoring it even when later alerts are meaningful. Alert fatigue is not just an inconvenience. It changes the operating environment in which surveillance occurs. A low-specificity tool can make it harder to notice truly important signals because staff become conditioned to discount them. For this reason, thoughtful deployment matters as much as model performance. Institutions need to decide who receives alerts, how often, at what threshold, and in connection with which actions [28]. An alert that appears in a passive dashboard is different from one that interrupts workflow. An alert intended to prompt review is different from one that implicitly recommends urgent imaging. These distinctions should be explicit before deployment, not discovered afterward through frustration.

Governance also extends to responsibility and review. If a digital system highlights concern, who is expected to respond, and within what time frame? If concern is dismissed, is that dismissal documented in a way that supports later learning? If the system performs inconsistently across units or patient groups, is anyone monitoring that pattern? Surveillance technology should be introduced as part of a managed clinical process, not as an isolated prediction tool. That process needs feedback. Teams should be able to identify when warnings were useful, when they were misleading, and when the system missed patients who later proved to have leak. Without such feedback, digital monitoring becomes a static instrument in a dynamic environment, and its apparent performance may drift away from its actual value.

Finally, practical governance requires humility about portability. A surveillance tool developed in one hospital may implicitly depend on local care patterns, testing frequency, or escalation culture. It may not transfer cleanly to another setting without recalibration or redesign. This is especially true for postoperative monitoring because the density and meaning of data are shaped by how each institution organizes recovery [29]. Rather than assuming that one solution will function identically everywhere, it is more realistic to treat digital surveillance as locally adapted infrastructure. The principles of longitudinal monitoring may be general, but the thresholds, displays, workflow links, and acceptable alert burden will remain partly contextual. Recognizing that does not weaken the case for digital support. It makes the case more realistic and therefore more likely to produce tools that are genuinely useful.

7 Postdischarge Monitoring and Continuity of Concern

Postoperative leak surveillance cannot end neatly at hospital discharge because the complication does not respect administrative boundaries. Earlier discharge after major surgery has many advantages when patients are truly ready, but it also compresses the period during which evolving complications are observed directly by the inpatient team. Some patients leave the hospital before a leak-compatible trajectory has become unmistakable. In those cases, the quality of surveillance depends less on what happened on the final inpatient day alone and more on whether concern, uncertainty, and follow-up planning were carried forward into the next setting.

This is especially important because the postdischarge environment is information poor compared with inpatient

care. Continuous monitoring disappears. Laboratory and imaging access become contingent rather than routine [30]. Patients and families must interpret symptoms that they may not know how to weigh. A surgical service that treats surveillance as ending at discharge effectively assumes that patients transition from structured observation to self-management without losing diagnostic safety. That assumption is often too strong. If a patient's inpatient recovery narrative was not fully reassuring, discharge should ideally convert unresolved concern into explicit follow-up structure rather than into silence. This may include earlier review, lower thresholds for contact, planned testing, or clearer instructions about which changes are meaningful.

The content of those instructions matters. Generic advice to return for fever, pain, or vomiting is necessary but often insufficient. Patients recovering from abdominal surgery expect discomfort, irregular appetite, fatigue, and fluctuating bowel function. They may normalize symptoms that, in context, deserve reassessment. Effective postdischarge surveillance therefore depends on communicating trajectory-based concerns in understandable language. A patient and family can be told not only which symptoms are dangerous, but what course should generally be expected over the next several days and which failures of progress should prompt contact. Statements such as worsening rather than steady improvement, inability to advance diet after initial progress, new fevers after an improving phase, or feeling suddenly less well after seeming to recover may provide a more usable framework than symptom lists alone [31].

Continuity between inpatient and outpatient teams is equally important. The clinicians who see a patient after discharge may not have the same operative memory or sense of how the recovery felt during admission. If unresolved concern existed in hospital but was never documented clearly, postdischarge clinicians may encounter the patient as if the course had been straightforward until the new complaint arose. A surveillance-oriented discharge summary should therefore do more than list procedures and final diagnoses. It should capture whether recovery was smooth, slow, or concerning in ways that never reached definitive diagnosis. This allows outpatient or emergency clinicians to understand new symptoms in relation to the preceding trajectory rather than as isolated events.

Telephone follow-up and early review clinics can serve a useful role when they are designed as surveillance tools rather than administrative check-ins. A conversation that asks only whether the patient is generally well may miss subtle but important drift. A more focused review can revisit intake, bowel function, mobility, pain evolution, fever, wound and drain changes, and the patient's overall sense of whether recovery is moving forward. The goal is not to recreate inpatient monitoring remotely. It is to detect whether the postdischarge course remains coherent with uncomplicated recovery. This approach also provides an outlet for patients who sense something is wrong but are uncertain whether it merits urgent attention [32]. In many cases, early postdischarge contact may not reveal a leak directly, but it can identify who should be seen sooner rather than later.

The rise of remote monitoring technologies has encouraged interest in digital postdischarge surveillance, but the same caution that applies in hospital applies here as well. Symptom check-ins, temperature logs, heart rate monitoring, or messaging systems can extend observation, yet they are most useful when linked to responsive clinical pathways. Data without a clear route to interpretation and action may create anxiety without improving recognition. Moreover, remote signals are usually less specific than inpatient ones. A modest tachycardia at home may reflect pain, dehydration, exertion, or device inaccuracy. The value of postdischarge digital monitoring therefore depends not on the volume of data captured, but on whether those data are framed within the recovery narrative and triaged through clinicians who understand the operation and inpatient course.

Readmission itself should also be viewed as part of the surveillance system rather than as its failure alone. When patients return with new symptoms, the question should not be limited to whether the present complaint is severe enough for admission. It should also include whether the current presentation completes an earlier pattern that was already visible in the initial recovery. Such reflection is useful not only for immediate care but for learning. Recurrent patterns of delayed recognition, especially after apparently borderline discharges, may indicate that the inpatient surveillance pathway is not adequately translating unresolved concern into postdischarge protection [33]. The lesson may lie in better documentation, clearer escalation instructions, or more selective early review, rather than simply in extending hospitalization for all.

Postdischarge surveillance therefore illustrates the broader theme of this paper. Leak recognition is not a single moment at which a test becomes positive. It is a continuous interpretive process that crosses settings, teams, and time points. When surveillance is strong, concern remains visible even as the patient moves away from the hospital. When surveillance is weak, each transition erases part of the trajectory, and the complication reappears later as though it had emerged from nowhere. In reality, it often did not emerge suddenly. The signals were present, but the continuity needed to carry them forward was incomplete.

8 Discussion

Reframing anastomotic leak around postoperative surveillance rather than purely preoperative prediction changes the conceptual center of the problem. Instead of asking mainly which patients are predisposed to leak, it asks how clinicians and systems can recognize that a recovery path is becoming incompatible with uncomplicated healing.

This shift may seem modest at first, but it has wide implications. It changes what counts as important data, how those data should be organized, how monitoring tools should be evaluated, and what kinds of failures matter most [34]. It also better reflects the clinical reality that recognition unfolds through repeated interpretation rather than through one definitive calculation performed before or immediately after surgery.

One implication is that surveillance must be understood as collective work. Leak recognition is rarely the product of one person noticing one variable. It emerges from accumulated observations across nurses, trainees, attending surgeons, intensivists, radiologists, and patients themselves. The electronic record can support this process, but it cannot substitute for it. Much of the practical challenge lies in converting dispersed concerns into a shared and durable narrative. If one clinician notices poor progression, another notices inflammatory persistence, and a third notices increasing unease at the bedside, surveillance succeeds only if those perceptions are linked rather than fragmented. In this sense, postoperative monitoring is as much about clinical communication architecture as about prediction.

A second implication is that ordinary recovery knowledge becomes central. Surveillance is only possible when teams have a clear sense of what normal and borderline recovery look like after different procedures. Without such expectations, delayed progress becomes easy to rationalize [35]. Conversely, when teams understand the expected sequence of stabilization, mobilization, intake, bowel recovery, and inflammatory resolution, deviations become more interpretable. This is one reason why procedure-specific pathways and operative memory matter. Surveillance is not generic watching. It is context-rich comparison between what is happening and what should plausibly be happening at this point for this patient.

A third implication concerns escalation culture. Because leak often becomes visible gradually, waiting for certainty can itself become a form of delay. Surveillance works better when teams are permitted to act on unresolved concern in graded ways. Repeat examination, repeated laboratory testing, senior review, focused imaging, or temporary intensification of monitoring can all serve as intermediate responses before definitive diagnosis is reached. Institutions that treat escalation as requiring binary proof may inadvertently delay recognition by making uncertainty difficult to express operationally. By contrast, a staged surveillance pathway gives uncertainty somewhere to go. It allows concern to change management before it hardens into unmistakable crisis.

This surveillance perspective also tempers enthusiasm for purely technical solutions [36]. Predictive tools may be useful, but they cannot overcome weak workflow, unclear ownership, or poor continuity on their own. A model that identifies risk without fitting communication pathways may add little. An alert that no one feels responsible for answering may be ignored. A dashboard that does not surface at the moment decisions are made may remain unseen. These are not implementation details in a trivial sense. They are part of the surveillance system itself. The practical value of a monitoring tool depends on whether it enters the right conversation at the right time and in a form that supports appropriate escalation. For leak recognition, this often matters as much as modest differences in statistical performance.

Another important point is that surveillance should remain proportionate. The goal is not universal maximal testing or suspicion. Overreaction carries costs, including unnecessary imaging, prolonged hospitalization, patient anxiety, and desensitization to warning systems. The objective is disciplined attention to trajectory quality [37]. This means distinguishing single transient abnormalities from persistent, converging, or stage-inappropriate deviations. It also means accepting that not every concerning pattern will prove to be leak. Surveillance is broader than leak diagnosis. It is a method of identifying patients whose recovery requires closer scrutiny because the current story no longer convincingly explains itself. Some of those patients will have alternative complications, and recognizing those complications earlier is also valuable.

The same reasoning suggests that surveillance can support learning at the service level. When leaks are recognized late, a useful retrospective question is not only whether the operation or technical outcome could have been improved, but whether the postoperative narrative contained earlier signs that were never integrated. This kind of review can identify weaknesses in handover, discharge planning, threshold setting, or follow-up structure. It can also reveal which signals tend to be ignored or overexplained in specific settings. In that sense, surveillance is not just a patient-level process. It is an institutional competency. Services become better at recognizing leak when they learn how deviation from expected recovery has presented in their own patients and how earlier concern could have been acted on more coherently [38].

A final implication is that postoperative surveillance allows preoperative prediction to find its appropriate place. Baseline risk remains useful, but not as the main answer. It is best understood as one way of setting initial vigilance. Patients at higher baseline risk may merit more structured follow-up, more careful discharge planning, or lower thresholds for review. Yet the actual detection of leak still depends on what happens after surgery. This balanced view avoids the false choice between baseline prediction and postoperative monitoring. The two are complementary, but they do not answer the same question. Once the operation is over, surveillance becomes the more immediate clinical task.

9 Conclusion

Anastomotic leak is most meaningfully approached as a postoperative surveillance problem because the complication becomes clinically recognizable through an evolving recovery trajectory rather than through a single static state. Preoperative risk estimation remains useful for planning and vigilance, but it cannot substitute for the ongoing interpretation of how a patient is actually recovering after surgery. The decisive signs of trouble often arise from persistence, timing, combination, and failure of expected improvement rather than from one isolated abnormal result.

A surveillance-centered view clarifies several practical priorities [39]. Recovery should be assessed longitudinally, not episodically. Mild abnormalities should be interpreted in relation to stage of recovery and overall narrative coherence. Escalation should be graded, allowing teams to respond to uncertainty before crisis makes the diagnosis obvious. Communication across shifts, units, and outpatient transitions should preserve unresolved concern rather than reset the clinical story at each handover. Digital tools can assist by organizing trajectories and surfacing persistent deviation, but their value depends on calibration to real actions, manageable alert burden, and fit with workflow.

This perspective also extends beyond the inpatient stay. Discharge does not end surveillance when the course remains only partially reassuring. Postdischarge review, clear instructions about trajectory rather than symptoms alone, and continuity of concern across settings are part of the same monitoring task. In that broader frame, postoperative leak recognition becomes less a matter of isolated diagnostic events and more a matter of maintaining an organized watch on recovery until the path back to ordinary convalescence is convincing.

The central practical shift is therefore straightforward. Instead of asking mainly who was likely to leak before the operation, postoperative care should ask who is no longer recovering as expected now. That question is the basis of timely recognition, and it is the place where surveillance has the greatest opportunity to improve care [40].

References

[1] M. C. Hernandez et al., "Machine learning and postoperative complications: Determining risk before surgery in patients with cancer.," *Journal of Clinical Oncology*, vol. 41, no. 16_{suppl}, pp. 6575–6575, Jun. 1, 2023. DOI: 10.1200/jco.2023.41.16_suppl.6575

[2] J. Tsang et al., "Appropriate timing for surgery after neoadjuvant chemoradiation for esophageal cancer.," *Diseases of the esophagus : official journal of the International Society for Diseases of the Esophagus*, vol. 30, no. 9, pp. 1–8, Jul. 19, 2017. DOI: 10.1093/dote/dox062

[3] L. Liu et al., "Impact of preoperative anemia on perioperative outcomes in patients undergoing elective colorectal surgery," *Gastroenterology research and practice*, vol. 2018, pp. 2 417 028–2 417 028, May 8, 2018. DOI: 10.1155/2018/2417028

[4] J. C. Woodfield, K. Clifford, B. Schmidt, G. A. Turner, M. A. Amer, and J. L. McCall, "Strategies for antibiotic administration for bowel preparation among patients undergoing elective colorectal surgery: A network meta-analysis.," *JAMA surgery*, vol. 157, no. 1, pp. 34–, Jan. 1, 2022. DOI: 10.1001/jamasurg.2021.5251

[5] C. J. R. Schlick et al., "A postdischarge venous thromboembolism risk calculator for inflammatory bowel disease surgery.," *Surgery*, vol. 169, no. 2, pp. 240–247, Oct. 17, 2020. DOI: 10.1016/j.surg.2020.09.006

[6] S. Holubar et al., "Biologics before surgery for ibd: Are they associated with post-operative infectious complications? results from the national surgical quality improvement program inflammatory bowel disease collaborative in ¿1500 patients," *Inflammatory Bowel Diseases*, vol. 27, no. Supplement_1, S57–S58, Jan. 1, 2021. DOI: 10.1093/ibd/izaa347.137

[7] H. A. E. Zaher et al., "Role of the triad of procalcitonin, c-reactive protein, and white blood cell count in the prediction of anastomotic leak following colorectal resections.," *World journal of surgical oncology*, vol. 20, no. 1, pp. 33–33, Feb. 12, 2022. DOI: 10.1186/s12957-022-02506-4

[8] S. Joglekar et al., "398. the hybrid intra-thoracic oesophago-gastric anastomosis—contemporary performance with low benign anastomotic stricture formation," *Diseases of the Esophagus*, vol. 36, no. Supplement_2, Aug. 30, 2023. DOI: 10.1093/dote/doad052.199

[9] R. H. Roth, M. J. Malfitano, M. Reilley, and L. W. Martin, *Delayed esophageal anastomotic complication and ramucirumab therapy: A case report.* Sep. 4, 2023. DOI: 10.1111/1759-7714.15084

[10] P. Mythili, "Conservative management of post-operative gi bile leaks," *Journal of Medical Science And clinical Research*, vol. 7, no. 10, Oct. 12, 2019. DOI: 10.18535/jmscr/v7i10.56

[11] C. L. Garey et al., "Esophageal perforation in children: A review of one institution's experience.," *The Journal of surgical research*, vol. 164, no. 1, pp. 13–17, Jun. 13, 2010. DOI: 10.1016/j.jss.2010.05.049

[12] A. Makki, "The pattern of causes of pneumoperitoneum-induced peritonitis: Results of an empirical study," *Journal of microscopy and ultrastructure*, vol. 5, no. 1, pp. 28–31, May 7, 2016. DOI: 10.1016/j.jmau.2016.04.004

[13] A. Penugonda et al., "Factors leading to post-operative leaks following bowel anastomosis in a tertiary care hospital: A prospective study," *Journal of Evidence Based Medicine and Healthcare*, vol. 6, no. 25, pp. 1736–1741, Jun. 24, 2019. DOI: 10.18410/jebmh/2019/353

[14] A. Davies et al., "Transhiatal esophagectomy in a high volume institution," *World journal of surgical oncology*, vol. 6, no. 1, pp. 88–88, Aug. 20, 2008. DOI: 10.1186/1477-7819-6-88

[15] C. Papadimitriou, W. Martin, A. E. Dellis, C. Deliveliotis, and I. Mitsogiannis, "Twenty-four-month efficacy of ureteroureterostomy combined with unilateral nephrostomy following radical cystectomy.," *Cureus*, vol. 14, no. 10, e30478–e30478, Oct. 19, 2022. DOI: 10.7759/cureus.30478

[16] V. Thiruvenkatarajan, E. J. Meyer, N. Nanjappa, R. M. V. Wijk, and D. Jesudason, "Perioperative diabetic ketoacidosis associated with sodium-glucose co-transporter-2 inhibitors: A systematic review," *British journal of anaesthesia*, vol. 123, no. 1, pp. 27–36, May 3, 2019. DOI: 10.1016/j.bja.2019.03.028

[17] R. Krouchev, S. Tamana, N. Nguyen, E. Yorke, D. Harris, and S. Sampath, "Total intracorporeal anastomosis for right hemicolectomy: Experience from a canadian center.," *American journal of surgery*, vol. 215, no. 5, pp. 905–908, Feb. 27, 2018. DOI: 10.1016/j.amjsurg.2018.02.013

[18] M. El-Ahmar et al., "Robotic colorectal resection in combination with a multimodal enhanced recovery program - results of the first 100 cases.," *International journal of colorectal disease*, vol. 38, no. 1, pp. 95–95, Apr. 13, 2023. DOI: 10.1007/s00384-023-04380-2

[19] S.-H. Chang et al., "Early major complications after bariatric surgery in the usa, 2003-2014: A systematic review and meta-analysis.," *Obesity reviews : an official journal of the International Association for the Study of Obesity*, vol. 19, no. 4, pp. 529–537, Dec. 20, 2017. DOI: 10.1111/obr.12647

[20] M. Liao et al., "Early enteral feeding on esophageal cancer patients after esophageal resection and reconstruction," *Annals of palliative medicine*, vol. 9, no. 3, pp. 816–823, Apr. 16, 2020. DOI: 10.21037/apm.2020.04.13

[21] A.-G. Chen et al., "Combined laparoscopic and thoracoscopic esophagectomy for esophageal carcinoma and gastro-esophageal anastomosis in right thoracic cavity: Analysis of 38 cases," *Chinese Journal of Thoracic and Cardiovaescular Surgery*, vol. 29, no. 09, pp. 525–527, Sep. 25, 2013.

[22] T. Hossain et al., "Ogc p25 outcomes of laparoscopic vs open oesophagectomy in a single high volume centre," *British Journal of Surgery*, vol. 109, no. Supplement$_9$, Dec. 7, 2022. DOI: 10.1093/bjs/znac404.188

[23] A. Slesser et al., "Compression versus hand-sewn and stapled anastomosis in colorectal surgery: A systematic review and meta-analysis of randomized controlled trials," *Techniques in coloproctology*, vol. 20, no. 10, pp. 667–676, Aug. 23, 2016. DOI: 10.1007/s10151-016-1521-8

[24] K. Ben-David, R. Tuttle, M. Kukar, G. Rossidis, and S. N. Hochwald, "Minimally invasive esophagectomy utilizing a stapled side-to-side anastomosis is safe in the western patient population," *Annals of surgical oncology*, vol. 23, no. 9, pp. 3056–3062, Apr. 25, 2016. DOI: 10.1245/s10434-016-5232-1

[25] V. Aslam, M. A. Khan, M. Bilal, and Z. ul Abidin, "One stage resection of sigmoid volvulus: An experience of 50 cases," *Journal of Postgraduate Medical Institute*, vol. 22, no. 3, Dec. 8, 2011.

[26] B. Sadanandan, "Data-driven risk stratification for anastomotic leak: A proof-of-concept study using electronic health records," *Journal of Data Science, Predictive Analytics, and Big Data Applications*, vol. 9, no. 6, pp. 1–27, 2024.

[27] J. C. Woodfield, K. Clifford, B. Schmidt, and M. Thompson-Fawcett, "Has network meta-analysis resolved the controversies related to bowel preparation in elective colorectal surgery?" *Colorectal disease : the official journal of the Association of Coloproctology of Great Britain and Ireland*, vol. 24, no. 10, pp. 1117–1127, Jun. 3, 2022. DOI: 10.1111/codi.16194

[28] M. N. N. Arron et al., "Mesenteric occlusive disease of the inferior mesenteric artery is associated with anastomotic leak after left-sided colon and rectal cancer surgery: A retrospective cohort study.," *International journal of colorectal disease*, vol. 37, no. 3, pp. 631–638, Jan. 7, 2022. DOI: 10.1007/s00384-021-04089-0

[29] J. V. Byrne, R. Stephens, A. Isaacson, H. Yu, and C. T. Burke, "Image-guided percutaneous drainage for treatment of post-surgical anastomotic leak in patients with crohn's disease," *UNC Libraries*, Apr. 18, 2020. DOI: 10.17615/grqa-mt05

[30] A. A. Berty, "Manual and mechanical cervical esophagogastric anastomosis after esophageal resection: A comparison," *International Journal of Surgery Science*, vol. 5, no. 2, pp. 98–101, Apr. 1, 2021. DOI: 10.33545/surgery.2021.v5.i2b.670

[31] R. L. Hoffman, H. Consuegra, K. C. Long, and C. J. Buzas, "Anastomotic leak in patients with acute complicated diverticulitis undergoing primary anastomosis: Risk factors and the role of diverting loop ileostomy," *International journal of colorectal disease*, vol. 36, no. 7, pp. 1543–1550, May 26, 2021. DOI: 10.1007/s00384-021-03957-z

[32] H. Linde, V. Bartusevicius, Å. Norberg, F. Klevebro, and J. Grip, "Frequency of blood lactate elevation following esophagectomy and its association to postoperative complications.," *Acta anaesthesiologica Scandinavica*, vol. 67, no. 3, pp. 277–283, Dec. 30, 2022. DOI: 10.1111/aas.14181

[33] K. Knight et al., "Aortic calcification is associated with non-infective rather than infective postoperative complications following colorectal cancer resection: An observational cohort study," *European radiology*, vol. 31, no. 6, pp. 4319–4329, Nov. 17, 2020. DOI: 10.1007/s00330-020-07189-7

[34] A. Mathew, G. Kaushal, D. Ramachandra, N. R. Rakesh, and P. Dhar, *Staple line dehiscence in gastric conduit following esophagectomy: A complication conspicuously missing a mention it deserves.* Jan. 25, 2022. DOI: 10.7759/cureus.21581

[35] B. Das, F. Ledesma, H. Ashrafian, M. Reddy, O. A. Khan, and M. Fehervari, "Gastrojejunostomy closure technique and risk of leak: An evaluation in ex vivo porcine models.," *Obesity surgery*, vol. 33, no. 3, pp. 978–981, Jan. 26, 2023. DOI: 10.1007/s11695-023-06470-0

[36] H. Masoomi, R. Luo, S. Mills, J. C. Carmichael, A. J. Senagore, and M. J. Stamos, "Compression anastomosis ring device in colorectal anastomosis: A review of 1,180 patients," *American journal of surgery*, vol. 205, no. 4, pp. 447–451, Jan. 2, 2013. DOI: 10.1016/j.amjsurg.2012.03.013

[37] N. Salim, C. Daidone, L. Smith, and A. Raza, "Robotic sigmoidectomy with natural orifice specimen extraction: A single-center experience.," *Cureus*, vol. 15, no. 12, e49902–e49902, Dec. 4, 2023. DOI: 10.7759/cureus.49902

[38] J. B. Mitchem et al., "What is the optimal management of an intra-operative air leak in a colorectal anastomosis?" *Colorectal disease : the official journal of the Association of Coloproctology of Great Britain and Ireland*, vol. 20, no. 2, O39–O45, Feb. 2, 2018. DOI: 10.1111/codi.13971

[39] H. M. Schardey, U. Wirth, T. Strauss, M. S. Kasparek, D. Schneider, and K. W. Jauch, "Prevention of anastomotic leak in rectal cancer surgery with local antibiotic decontamination: A prospective, randomized, double-blind, placebo-controlled single center trial," *International journal of colorectal disease*, vol. 35, no. 5, pp. 847–857, Feb. 27, 2020. DOI: 10.1007/s00384-020-03544-8

[40] S. Şenol and D. B. Özdemir, "A novel stent fixation method for anastomotic leaks after gastrectomy: Anchoring of the distal flare to the jejunum by using through-the-scope endoclips.," *Przeglad gastroenterologiczny*, vol. 18, no. 4, pp. 416–420, Nov. 10, 2022. DOI: 10.5114/pg.2022.121045