

# The Structural Flaw at the Heart of Anaesthetic Record Keeping

*The anaesthetic record is, by design, a work of reconstruction. That it is also expected to be accurate is one of medicine's more persistent contradictions. This paper examines why, demonstrating that the problem is not one of knowledge or discipline, but of structure.*

## A White Paper in Five Parts

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## Part One

# The Environment

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Before examining the documentation problem in anaesthesia, it is worth being precise about the environment in which it occurs. It is an environment that most people outside the theatre have never had to think about carefully. Anaesthesiologists live in it every working day.

Six characteristics define it. Together they create a situation that is unlike almost any other professional environment in medicine, making the documentation problem not merely difficult but structurally insoluble by conventional means.

### 1. Unpredictability

No case unfolds exactly as anticipated. The patient who was stable in pre-assessment deteriorates on induction. The straightforward procedure encounters an unexpected finding. The planned forty-minute case runs to two hours. Anaesthesia is practised against a background of constant, low-level uncertainty punctuated by moments of acute, high-stakes unpredictability. Planning and preparation mitigate this. They do not eliminate it. The environment demands continuous real-time adaptation in a way that few other medical disciplines match.

### 2. The Conveyor Belt

Despite its unpredictability, the theatre list moves forward relentlessly. Cases follow cases. The surgeon, the theatre coordinator, the nursing staff, and the institution all apply pressure, explicit or implicit, to maintain throughput. The gap between cases is not rest time. It is borrowed time, claimed from the momentum of the list to handle everything that could not happen during the case itself. Documentation, equipment checks, telephone calls, patient reviews. The conveyor belt does not stop. It merely slows briefly before accelerating again.

### 3. Administration is Downstream of Clinical Work, by Definition

This point is so obvious it is rarely stated, yet it has profound implications. You cannot document an induction before it happens. You cannot record a drug dose before it is given. You cannot note a complication before it occurs. The administrative record is, by the laws of time and causality, always downstream of the clinical event it describes. This is not a workflow choice. It is a physical reality. The only question is how far downstream: seconds, minutes, hours, or the following day.

### 4. Reconstruction is Inevitable: the Question is Only the Delay

It follows from the above that some degree of reconstruction is always involved in creating an anaesthetic record. Even a note made thirty seconds after an event is a reconstruction: a memory translated into written form. The difference between a contemporaneous note and an end-of-list reconstruction is not a difference in kind. It is a difference in degree. In the delay. And delay matters

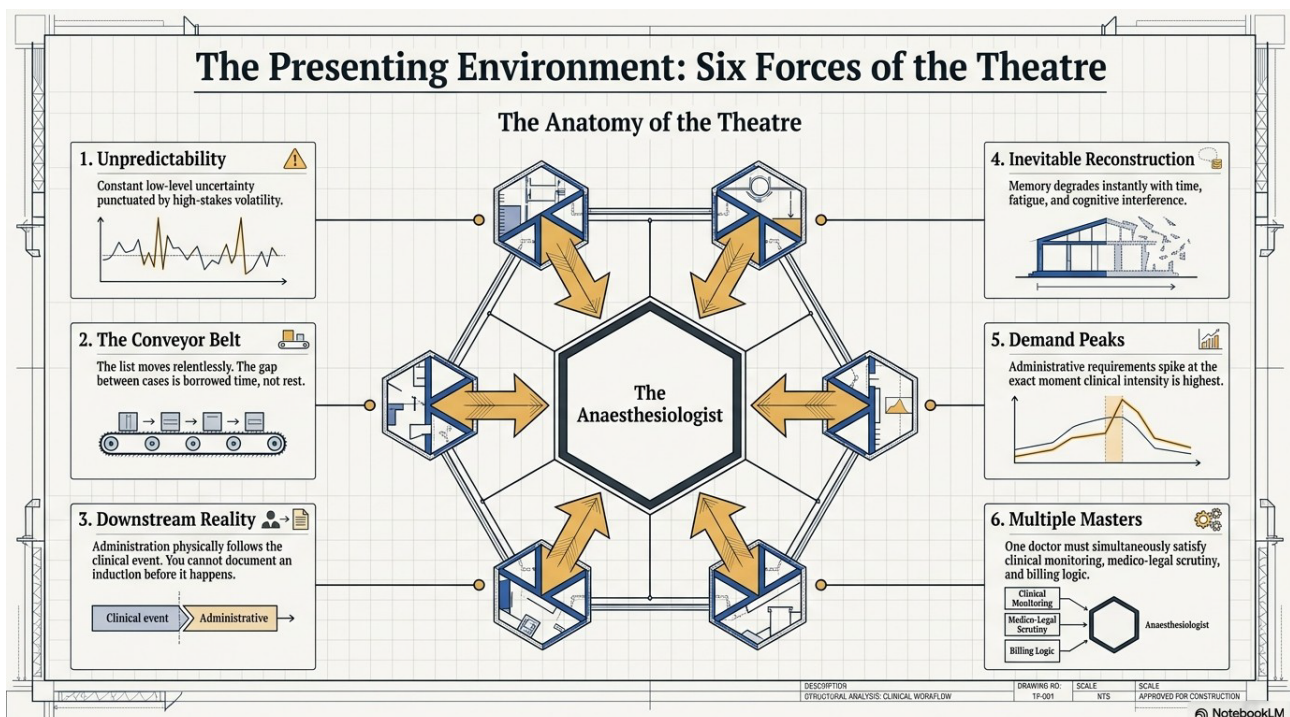
enormously, because memory is not a recording device. It is a reconstructive process that degrades with time, fatigue, and the cognitive interference of subsequent events. The question is never whether reconstruction occurs. It is how much degradation has accumulated by the time the pen meets the paper.

## 5. Administrative Demand Peaks at Clinical Intensity

This is the sharpest characteristic of the theatre environment and the one that makes the documentation problem genuinely intractable by conventional means. The moments that generate the most significant documentation requirements, including induction, a critical event, a complication, or an unexpected development, are precisely the moments of highest clinical demand. When the anaesthesiologist most needs to be fully present for the patient, the administrative requirement is also at its highest. The two demands do not take turns. They arrive simultaneously. And they compete for the same finite cognitive resource.

## 6. The Record Serves Multiple Masters: One Person Must Satisfy All of Them

The anaesthetic record is not a single document serving a single purpose. It is simultaneously a clinical monitoring tool, a medico-legal document, a billing instrument, and a quality assurance mechanism. Each function has different requirements for what constitutes completeness and accuracy. A record that satisfies clinical continuity may not satisfy billing requirements. A record that satisfies billing may not withstand medico-legal scrutiny. And the anaesthesiologist, working alone without redundancy or a parallel documentation stream, is expected to produce a record that satisfies all of these masters simultaneously. No other member of the theatre team carries an equivalent burden. The anaesthetic record is a single-author document in a multi-stakeholder world.



These six characteristics do not operate in isolation. They compound each other. The unpredictability of the environment makes the conveyor belt harder to manage. The conveyor belt compresses the time available for documentation. The downstream nature of administration means reconstruction is always involved. The peaking of administrative demand at clinical intensity means reconstruction happens under the worst possible conditions. And the multiple-master requirement means that whatever record emerges must simultaneously satisfy standards it was never optimally created to meet. The result is an environment in which the doctor, however skilled and diligent, faces an impossible documentation task before the first patient has even entered the theatre. Part 2 examines how doctors have responded to this reality, and why every available response is inadequate.

## Part Two

# The Clinical Response: Three Inadequate Options

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Into this environment steps the anaesthesiologist. Clinically prepared, professionally experienced, and immediately confronted with an impossible documentation choice that the environment described in Part 1 has created. This part examines how doctors have responded to that challenge, demonstrating that every available response, however rational, is structurally inadequate.

The choice is not between a good option and a bad one. It is between three options that are each, in their own way, deficient. Understanding why requires nothing more than examining what each option actually demands.

## 2.1 Option One: Document in Real Time

The first response is to document events as they happen, contemporaneously, during the case. The appeal is obvious. A real-time record is accurate. It reflects what actually occurred because it was created in the moment of occurrence. There is no reconstruction. There is no degraded memory. The record and the clinical reality are, at least in theory, identical.

In practice, the cost is significant. Every act of documentation is a moment of divided attention in an environment where divided attention carries clinical risk. Research comparing manual and automated anaesthesia record keeping has found that anaesthesiologists using manual documentation spent more than one in every five minutes of anaesthesia time on record keeping activities, time that was directly unavailable for patient care. And this cost is highest at precisely the worst moments, including induction, complications, during the unpredictable events that define the environment described in Part 1.

In a stable, routine case, the cost of real-time documentation is manageable. But anaesthesia is not uniformly stable. The window for safe documentation is unpredictable. It can close without warning and without announcement. A doctor who commits to contemporaneous documentation accepts a continuous,

variable, and uncontrollable distraction at the moments when distraction is least affordable.

## **2.2 Option Two: Reconstruct the Record Afterwards**

The second response is to protect clinical attention during the case entirely, letting the procedure run uninterrupted and complete the documentation once the patient is stable and the immediate demands of the case have passed. This is the most common response in South African private anaesthesia practice, and it is easy to understand why. The clinical process runs cleanly. The administrative burden is deferred. The doctor is fully present for the patient during the case itself.

The cost emerges later. The record is now being built from memory. Memory formed under cognitive load. Memory that began degrading the moment clinical attention shifted to the next patient. Memory that is not random in its failures: it is selective. We forget the things that seemed minor at the time, which are often the modifiers, supplementary procedures, and precise time events that carry the greatest billing and medico-legal consequence.

The anaesthetic record serves simultaneously as a clinical monitoring tool, a medico-legal document, and an instrument for research and quality improvement, and all of these functions depend entirely on the accuracy and comprehensiveness of what it contains. Retrospective reconstruction quietly undermines all three. A record completed from memory an hour after the case reflects what the doctor remembers, not necessarily what happened. The gap between the two is invisible in the final document.

## **2.3 Option Three: The Hybrid**

The third response, and the one most anaesthesiologists actually use, is a hybrid of the first two. Capture the obvious things in real time. Reconstruct the rest afterwards. This feels like a reasonable compromise between the competing demands of clinical attention and documentary accuracy.

In practice it inherits the worst of both options. The real-time elements are captured selectively and inconsistently, because the moments available for safe documentation are unpredictable and brief. The reconstructed elements carry all the accuracy problems of delayed memory. And the boundary between what was captured live and what was filled in later is invisible in the final record, producing a document that looks complete but contains an unknown mixture of contemporaneous fact and retrospective inference.

The hybrid is not a solution. It is an adaptation. A way of managing an impossible situation that the environment created and that conventional tools have never resolved.

| The Clinical Response: Three Inadequate Options                                                                                                                                                                                                             |                     |               |             |                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------|-------------|------------------------|
| The Impossible Choice Matrix                                                                                                                                                                                                                                |                     |               |             |                        |
|                                                                                                                                                                                                                                                             | Cognitive Cost      | Clinical Risk | Accuracy    | Medico-Legal Integrity |
| <b>Option 1: Real-Time Documentation</b><br>Note: Costs >20% of anaesthesia time.                                                                                                                                                                           | HIGH ⚠️             | HIGH ⚠️       | HIGH ✅      | GOOD ✅                 |
| <b>Option 2: Retrospective Reconstruction</b><br>Note: Selective memory hides critical billing modifiers.                                                                                                                                                   | LOW (during case) ✅ | LOW ✅         | DEGRADED ⚠️ | POOR ⚠️                |
| <b>Option 3: The Hybrid</b><br>Note: The most common adaptation, inheriting the worst of both.                                                                                                                                                              | VARIABLE ➡️         | VARIABLE ➡️   | UNKNOWN ⚠️  | MIXED ➡️               |
| The fact that every rational professional response is inadequate is a diagnostic finding.                                                                                                                                                                   |                     |               |             |                        |
| <div> <div>DESCRIPTION</div> <div>STRUCTURAL ANALYSIS: CLINICAL WORKFLOW</div> </div> <div> <div>DRAWING NO.</div> <div>TF-001</div> </div> <div> <div>SCALE</div> <div>675</div> </div> <div> <div>SCALE</div> <div>APPROVED FOR CONSTRUCTION</div> </div> |                     |               |             |                        |

## 2.4 What These Three Responses Tell Us

The significance of these three options lies not in their individual deficiencies but in what they collectively reveal. Together, they represent the full range of rational responses available to a skilled professional facing a documented structural constraint. Every anaesthesiologist in private practice has tried all three. Most have settled on the hybrid as the least inadequate of the available options.

The fact that every rational response is inadequate is itself a diagnostic finding. It tells us something important about the nature of the problem, something that Part 3 examines in detail.

## Part Three

### Diagnosing the Problem: A Structural Analysis

Part 2 demonstrated that every available documentation response is inadequate. This is an important observation, but it is not yet a diagnosis. The question now is: what kind of problem produces this pattern? What does it mean when a skilled professional, applying intelligence and experience, cannot find a satisfactory solution within the available options?

The answer requires a precise understanding of what distinguishes a structural problem from other kinds of problems. That distinction is the subject of this part.

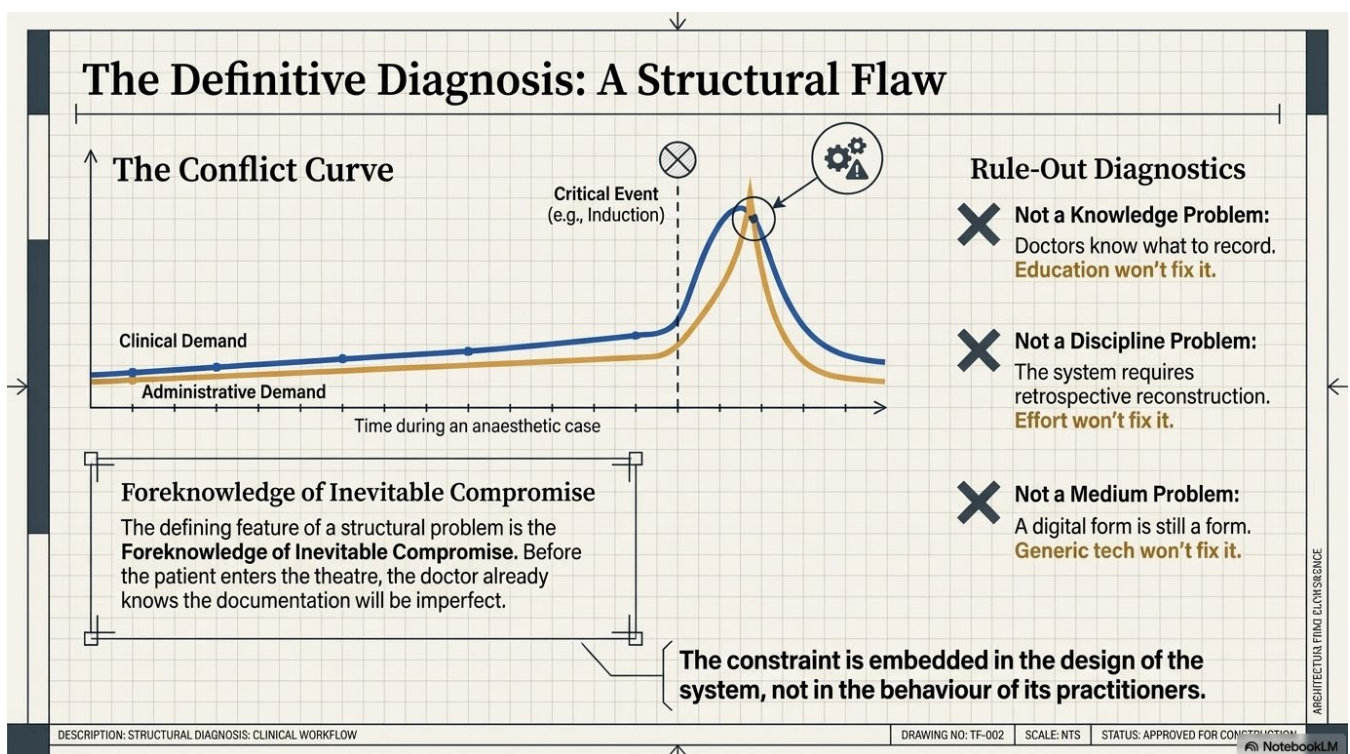
### 3.1 What Makes a Problem Structural?

A problem is structural when it arises not from the behaviour of the participants but from the design of the system in which they operate. The key diagnostic feature of a structural problem is this: the affected party knows, before attempting the task, that certain outcomes will be unsatisfactory, however hard they try. The inadequacy is built into the situation, not into the person.

Applied to anaesthesia documentation, the structural diagnosis is clear. Before the first patient enters the theatre, the anaesthesiologist already knows that the documentation will be imperfect. If he documents in real time, clinical attention will be compromised at unpredictable moments. If he reconstructs afterwards, accuracy will degrade with time and fatigue. If he adopts the hybrid, he inherits both problems in smaller doses. The trade-off is not a consequence of poor choices. It is the defining characteristic of the situation itself.

This foreknowledge of inevitable compromise is the hallmark of a structural problem. It distinguishes the documentation dilemma in anaesthesia from a knowledge problem (which would be solved by better training) or a discipline problem (which would be solved by better habits). Neither training nor discipline changes the fundamental constraint that clinical attention is finite, that administrative demand peaks at clinical intensity, and that the tools available have never allowed both processes to run independently of each other.

***The problem is structural. It is embedded in the design of the system, not in the behaviour of its practitioners. It persists because no available tool has ever allowed the clinical and administrative processes to be genuinely separated.***



### **3.2 What the Problem is Not**

Precision requires ruling out the alternatives.

It is not a knowledge problem. Anaesthesiologists know what needs to be recorded, when it needs to be recorded, and what the consequences of incomplete documentation are. The problem does not arise from ignorance and cannot be solved by education.

It is not a discipline problem. The anaesthesiologist who reconstructs the record from memory at the end of a list is not being careless. He is doing what the system requires of him, in the only way the system has ever allowed it to be done. Asking him to be more diligent or more contemporaneous does not change the fundamental reality. The constraint is not in the person. It is in the design.

It is not a technology problem in the conventional sense. A digital form is still a form. A voice transcription of a retrospective reconstruction is still a reconstruction. Changing the medium does not change the structure. The history of anaesthesia documentation is littered with technological interventions that improved the efficiency of an inadequate process without addressing the inadequacy itself.

### **3.3 The Research Confirms the Diagnosis**

Identifying the problem as structural is not a novel insight. The research literature has been circling this conclusion for four decades, though it has rarely stated it in these terms.

Research on automated anaesthesia record keeping stretches back to the 1980s. The findings have been remarkably consistent. Automated record keeping systems improve the accuracy of anaesthesia documentation and reduce the cognitive burden on clinicians, without any compromise to clinical vigilance. The evidence has been building across four decades. Lighter documentation burden. Same clinical performance. Better record.

These findings are consistent with a structural diagnosis. If the problem were one of knowledge or discipline, training and auditing would show measurable improvement over time. They do not. The problem persists despite extensive awareness of it, precisely because awareness does not change the structure. Only a structural intervention: one that redesigns the relationship between the clinical process and the documentary process, produces consistent improvement. The research confirms this. The widespread adoption of that insight has not followed, for reasons examined in Part 5.

### **3.4 The Same Problem Appears Elsewhere**

A structural problem is recognisable by its recurrence across different contexts. If the dilemma were unique to anaesthesia, it might be explained by specialty-specific factors. But it is not unique to anaesthesia.

Surgeons reconstruct operative reports from memory after procedures lasting several hours. Interventional cardiologists and radiologists work in high-

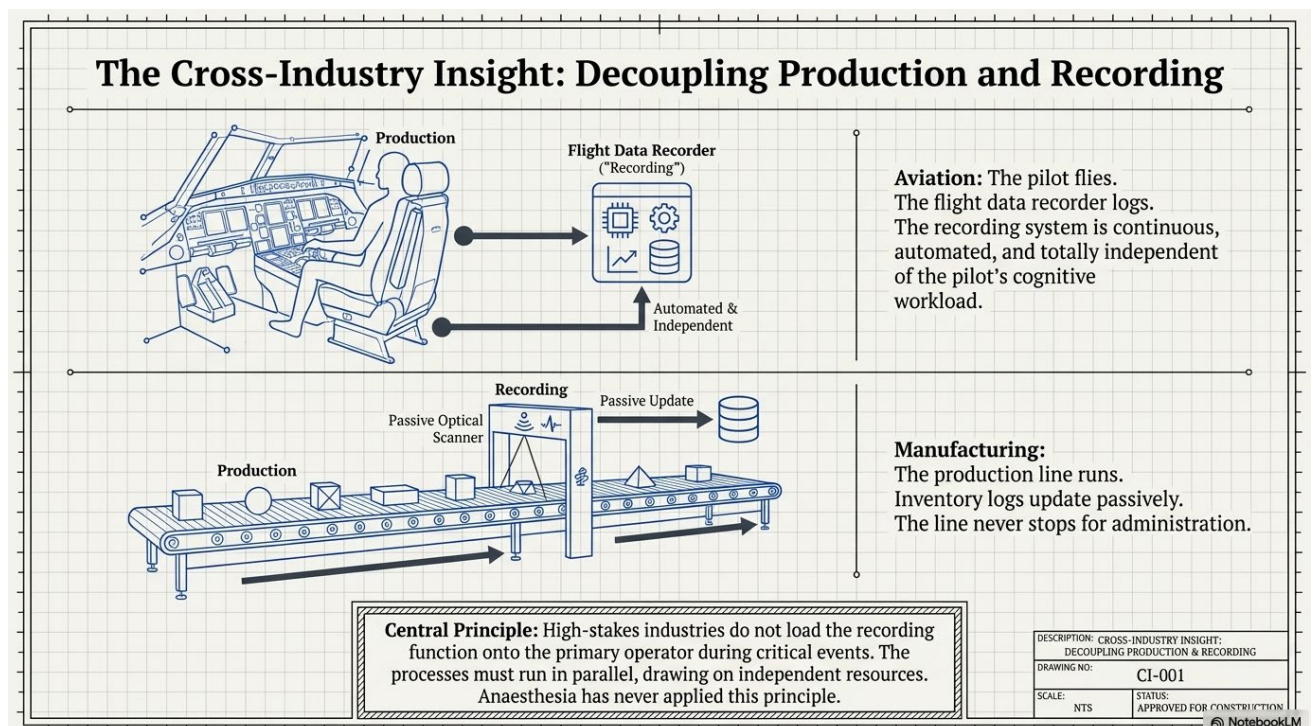
intensity environments with time-based billing and complex modifier structures, documenting events that occurred faster than they could be recorded. Obstetricians face perhaps the most acute version of all: intrapartum events that unfold rapidly, unpredictably, and with extreme medico-legal consequence, documented retrospectively, sometimes by clinicians who were not present when they occurred.

The same structural dilemma appears wherever three conditions coincide: the clinical environment is active and demanding; the billing or medico-legal record requires granular, time-sensitive detail that degrades rapidly in memory; and the administrative output is disconnected from the clinical process. Anaesthesia is simply the discipline where these three conditions are most concentrated and most consequential.

### 3.5 Other Industries Recognised This Problem and Solved It

The structural nature of the problem becomes clearest when viewed through the experience of other high-stakes industries that faced equivalent challenges and resolved them.

Aviation did not ask the pilot to maintain the flight data recorder while flying the aircraft. The recording function was assigned to a dedicated automated system, completely independent of the pilot's cognitive workload. The pilot flies. The recorder records. Simultaneously. Neither process interferes with the other. The flight data recorder does not depend on the pilot's memory. It does not degrade in accuracy as the flight progresses. It does not compete with the flying function for the pilot's attention.



Manufacturing production lines do not stop the line to update the inventory system. The recording function runs alongside the production function, fed by inputs that capture what is happening without interrupting it. Two processes. One system. Neither loading the other.

In both cases the insight was the same: the productive process and the recording process must be decoupled. They must run in parallel, each drawing on its own resources, neither one interrupting the other. This is not a technological insight. It is a structural one. The technology required to implement it varies. The principle is universal.

Anaesthesia has never applied it. The anaesthesiologist has remained responsible for both the clinical process and the documentary record of it, simultaneously, with the same finite cognitive resources, in an environment where the clinical demands are unpredictable and cannot be deferred. The structural solution that other industries implemented decades ago has never been practically assembled for the anaesthesia context in a form that is affordable, clinically appropriate, and connected to the billing and medico-legal outcomes the record is required to produce. Part 4 examines what that solution must look like.

### **3.6 A Second Structural Flaw: Information Fragmentation**

There is a second structural dimension to the problem: information does not travel. Each stage of the case begins with a partial or empty record, relying on the doctor's memory or manual re-entry to fill the gaps. The theatre list is not connected to the pre-operative record. The pre-operative record is not connected to the intraoperative capture. The intraoperative capture is not connected to the billing system. This fragmentation is not a workflow choice. It is a structural condition of the current system — one the doctor cannot resolve by changing his behaviour, because the connections between stages simply do not exist.

## What Has Been Tried: A Survey of Current Solutions

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Part 3 established that the documentation problem in anaesthesia is structural. To understand how the industry has attempted to solve this problem we look at some examples.

### 4.1 Dictation and Transcription Tools

The oldest and most widely adopted approach to reducing documentation burden is dictation. Rather than writing a record, the doctor speaks it. The technology transcribes the speech into text. The record is produced faster than typing and with less physical effort.

Dragon Medical One, developed by Nuance and now owned by Microsoft, is the dominant product in this category globally. It offers cloud-based speech recognition with claimed accuracy exceeding 99% from first use, adapts to medical terminology and regional accents, and integrates with most major electronic health record systems. It is fast, reliable, and widely adopted across general practice and specialist consulting environments.

Heidi Health, an Australian company that has raised nearly \$100 million in funding and now supports over two million consultations per week in 116 countries, represents the sophisticated evolution of this category. Rather than simply converting speech to text, Heidi uses ambient listening to capture an entire clinical encounter and generates structured clinical notes, referral letters, and coding suggestions automatically.

Both products are genuinely impressive within their domain. That domain, however, is the consultation room: the GP or specialist sitting across from a patient, conducting a conversation that can be listened to and transcribed. A theatre anaesthetic case is not a conversation. It has no dialogue to transcribe. The clinical information is not spoken; it is lived, event by event, over several hours, in a noisy, procedurally intense environment. In a theatre, the most important information is not said at all. It happens.

More fundamentally, both products address the medium of documentation without addressing its structure. A doctor who dictates a retrospective account of a case at the end of a theatre list is still reconstructing from memory. The dictation is faster than writing. The structural problem is completely unchanged.

### 4.2 Digital Form Solutions

The second category replaces paper with a screen. The workflow is identical to the traditional green form: the doctor completes a record of the case, but the medium is digital rather than physical. The completed record is stored electronically, can be transmitted automatically, and is legible regardless of the doctor's handwriting.

MxNode, integrated with the Healthbridge practice management platform, is the primary SA-specific product in this category, positioned as a simple, powerful application designed for the anaesthesiologist on the move.

Digital forms represent a meaningful improvement over paper. The record is legible, storable, transmittable, and connected to downstream billing processing. These are genuine advantages. But the structural problem is untouched. The doctor still completes the form using the same three options described in Part 2, each of which is inadequate for the reasons described there. The screen is cleaner. The system is the same.

### **4.3 Practice Management and Billing Systems**

South Africa has a mature market of practice management and billing systems. GoodX, one of the longest-running solutions in the country, offers scheduling, billing, patient management, and reporting across virtually every medical discipline. Healthbridge, with nearly 7,000 private medical practices on its platform, specialises in billing and claims management with deep integration into South African medical aid schemes. Both systems are sophisticated and well-integrated.

What they do is manage the downstream administrative process: once the clinical record exists, they process it into claims, submit it to medical aid schemes, track payment, and manage the financial health of the practice. They share one structural characteristic: they assume the clinical record already exists and is complete when they receive it. Their presence in the workflow begins after the theatre has closed.

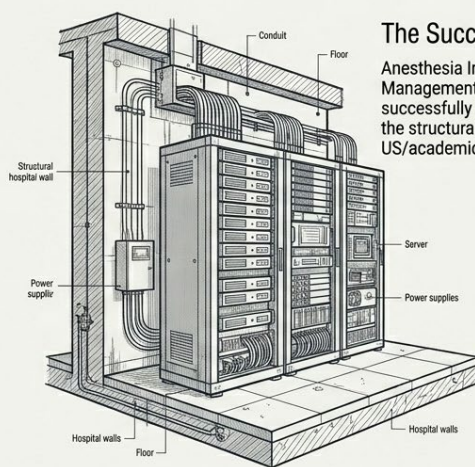
Alchemed Anaesthesia represents an interesting partial exception. It has recognised the upstream opportunity and built a pre-operative assessment module that enables structured patient capture before the day of surgery, moving some documentation work to the calmer pre-operative stage as the framework in Part 4 recommends. The instinct is correct. But the module addresses upstream capture only, without connecting to intraoperative capture or an intelligence engine that translates captured events into billing output. The upstream layer exists. The continuity to the next stage does not.

### **4.4 Anesthesia Information Management Systems**

The fourth category is the most technically sophisticated and the most instructive, because it is the category that has come closest to addressing the structural problem, and yet has remained largely inaccessible to the South African private anaesthesia market.

Anesthesia Information Management Systems, known as AIMS, are purpose-built electronic records platforms for anaesthesia, in development and deployment since the 1980s. The leading products, Provation iPro, Picis Anesthesia Manager, MetaVision by iMDsoft, and Anesthesia Touch, interface directly with anaesthetic monitors and patient monitoring devices to capture physiological data automatically in real time, support structured pre-operative and post-operative documentation within the same system, and connect to hospital information systems for billing and clinical record keeping.

## The AIMS Paradox: Right Structure, Wrong Market



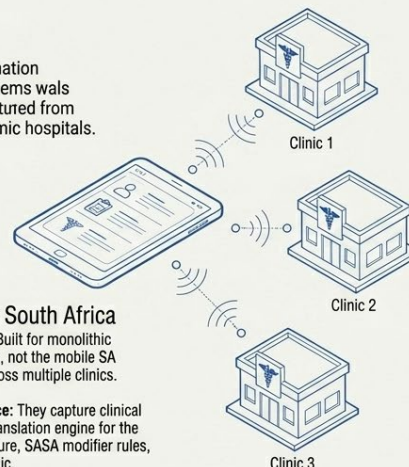
### The Success

Anesthesia Information Management Systems successfully implement the structural model in US/academic hospitals.

Enterprise AIMS (Academic / US)

### The Dolor

Anesthesia Information Management Systems was originally created from the NHRPL academic hospitals.



### The Reality for South Africa

- **Hardware Bound:** Built for monolithic hospital IT systems, not the mobile SA doctor working across multiple clinics.
- **Missing Intelligence:** They capture clinical data but lack the translation engine for the NHRPL tariff structure, SASA modifier rules, and medical aid logic.

SA Private Practitioner

NotebookLM

These are genuine implementations of the structural model described in Part 4: upstream capture, intraoperative automation, downstream confirmation, and information continuity throughout. Institutions that have implemented AIMS report improvements in record accuracy, reductions in documentation time, better billing capture, and measurable improvements in quality assurance and compliance. One institution increased billing capture for epidural catheters, central lines, and arterial catheters simply by using AIMS to prompt clinicians when triggering events were detected, revenue previously lost in retrospective reconstruction.

Yet despite forty years of development and demonstrated effectiveness, AIMS adoption has remained stubbornly low. As recently as the mid-2000s, fewer than 5% of US operating rooms had an AIMS installation. The reasons are well understood. AIMS are hospital-grade enterprise systems requiring physical integration with specific monitoring hardware, significant IT infrastructure, institutional procurement processes, and lengthy implementation projects. They are not designed for the mobile private practice anaesthesiologist who works across three hospitals and two day clinics, using different monitor brands at each site, with no institutional IT team to manage the integration.

More critically for the South African context, they are designed for integration with international hospital information systems, specifically Epic, MEDITECH, and Altera Digital Health. The South African private practice billing environment, with its NHRPL tariff structure, medical aid scheme integrations, SASA modifier rules, and procedural dominance logic, is simply not the market these systems were built for. And even setting aside the integration challenge, AIMS automate data capture but do not apply billing intelligence. They produce a comprehensive clinical record. They do not determine whether a femoral nerve block under ultrasound guidance performed on a 76-year-old patient with a BMI of 35.9 qualifies for the combination of modifiers that correctly reflects the clinical complexity in a South African medical aid claim. The intelligence

layer, which translates captured clinical events into correct, deterministic SA-specific billing output, is absent.

## **4.5 Billing Bureaus and Coding Services**

The final category is the most human and the most practically impactful for many South African anaesthesiologists. Rather than managing the administrative process themselves, a significant proportion of private practitioners outsource it entirely to specialist medical billing bureaus that handle coding, claim submission, medical aid liaison, and debt collection on behalf of the doctor.

The bureau market in South Africa is mature, competitive, and staffed by experienced operators with deep knowledge of the SA tariff framework. Several have been in operation for decades and serve hundreds of specialist practitioners across the country. Collection rates of 95% or more of submitted claims are achievable by established bureaus, a genuine measure of the expertise applied to the downstream process. Some bureaus have developed mobile applications that allow practitioners to submit clinical data directly from their smartphones. At least one operator has gone further, combining an anaesthesiology practice with a dedicated billing bureau for anaesthesiologists and critical care specialists, an arrangement that reflects how well the problem is understood by those closest to it.

These services are genuinely valuable. For a solo anaesthesiologist with a busy theatre list and no administrative staff, outsourcing to a specialist bureau is rational, cost-effective, and produces measurably better financial outcomes than self-management.

But billing bureaus share one structural characteristic with every other category reviewed above: they work from whatever information the doctor provides. They cannot recover what was never captured. They cannot claim a modifier that was not documented. The bureau applies expert coding knowledge to the record it receives. It cannot compensate for what the record does not contain. The bureau is the most skilled practitioner of the downstream process, entirely dependent on the quality of what arrives from the intraoperative and post-operative stages. That dependency is the structural problem, expressed in commercial terms.

## **4.6 What the Landscape Reveals**

Surveyed honestly, the existing landscape has evolved considerably. Dictation tools have reduced the friction of verbal reconstruction. Digital forms have replaced paper. AIMS have solved the structural problem elegantly in well-resourced hospital environments. Practice management systems have become sophisticated downstream processors. Billing bureaus apply professional expertise to maximise recovery from whatever record arrives.

| Market Landscape: A Survey of Failed Therapies                                                 |                                                                  |                             |                                                                                   |                                                                                              |
|------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|                                                                                                | Upstream Capture                                                 | Low Intraoperative Friction | Information Continuity                                                            | SA-Specific Billing Intelligence                                                             |
| Dictation                                                                                      | ✗                                                                | ✓                           | ✗                                                                                 | ✗                                                                                            |
| Digital Forms                                                                                  | ✗                                                                | ✗                           | ✓                                                                                 | ✗                                                                                            |
| Practice Mgmt                                                                                  | ✗                                                                | ✗                           | ✗                                                                                 | ✓                                                                                            |
| Billing Bureaus                                                                                | ✗                                                                | ✗                           | ✗                                                                                 | ✓                                                                                            |
| Dictation<br>Solves friction, fails structure. It is just faster retrospective reconstruction. | Digital Forms<br>Changes the medium, workflow remains unchanged. |                             | Practice Mgmt<br>Post-theatre downstream processors; absent at the point of care. | Billing Bureaus<br>Structurally dependent on whatever incomplete memory the doctor provides. |

Each category addresses a real problem. None addresses all three requirements of a structural solution simultaneously. The dictation and transcription tools change the medium but not the structure. The digital form solutions improve legibility and connectivity but leave the documentation workflow unchanged. The practice management and billing systems optimise the downstream process but have no presence at the point of care. The AIMS address the structural problem correctly but are inaccessible to the private practice market they do not serve. The billing bureaus apply expertise downstream but cannot compensate for what was lost upstream.

## Part Five

# Towards a Solution – seven components must be addressed

Before describing the seven components, it is necessary to establish the architectural framework on which the solution should be built. An anaesthetic case has three natural stages, each with a fundamentally different cognitive character. The solution is organised around this architecture.

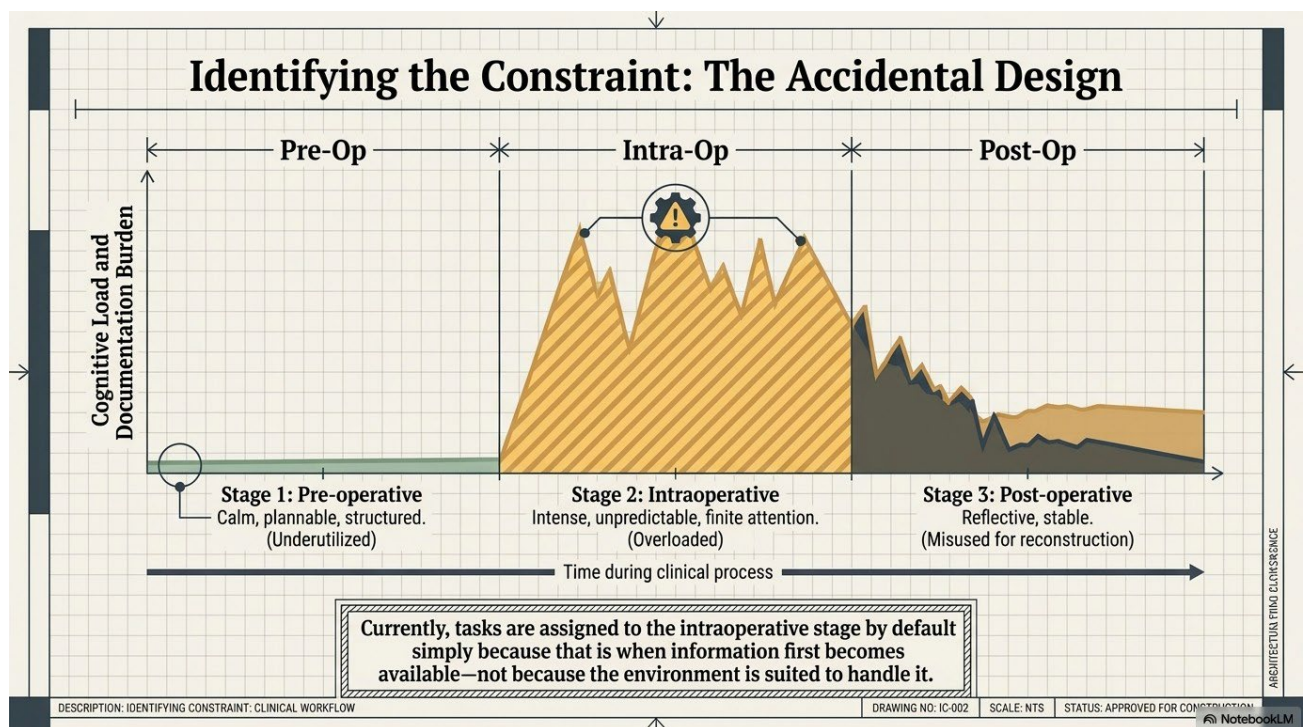
**The pre-operative stage** is calm and plannable. The patient has been assessed. The procedure is known. There is time to think, prepare, and gather information without the pressure of an active clinical situation. This is the stage best suited to documentation work.

**The intraoperative stage** is intense and unpredictable. Clinical demands are high and variable. Attention is finite and continuously claimed. This is the worst possible cognitive environment for administrative work — yet it is where almost all documentation currently occurs. The solution must protect this stage from non-essential cognitive load.

**The post-operative stage** is reflective and structured. The acute clinical demands have passed. The patient is stable. In a correctly designed system this stage involves confirmation of a substantially complete record, not reconstruction from memory.

Each component described below addresses a specific dimension of the structural flaw by assigning the right task to the right stage, with the right tools to support it.

Eliyahu Goldratt, whose Theory of Constraints has shaped operations management thinking since the publication of *The Goal* in 1984, described the underlying principle directly: **identify the constraint, protect it, and subordinate everything else to it.**



Loading non-constraint work onto the constraint is the cardinal error of system design. Applied to the anaesthetic case, the constraint is the anaesthesiologist's intraoperative cognitive attention. Everything that can be moved away from that constraint, upstream or downstream, should be moved. Everything that must remain should be made as light as possible. The solution described below is a systematic application of this principle.

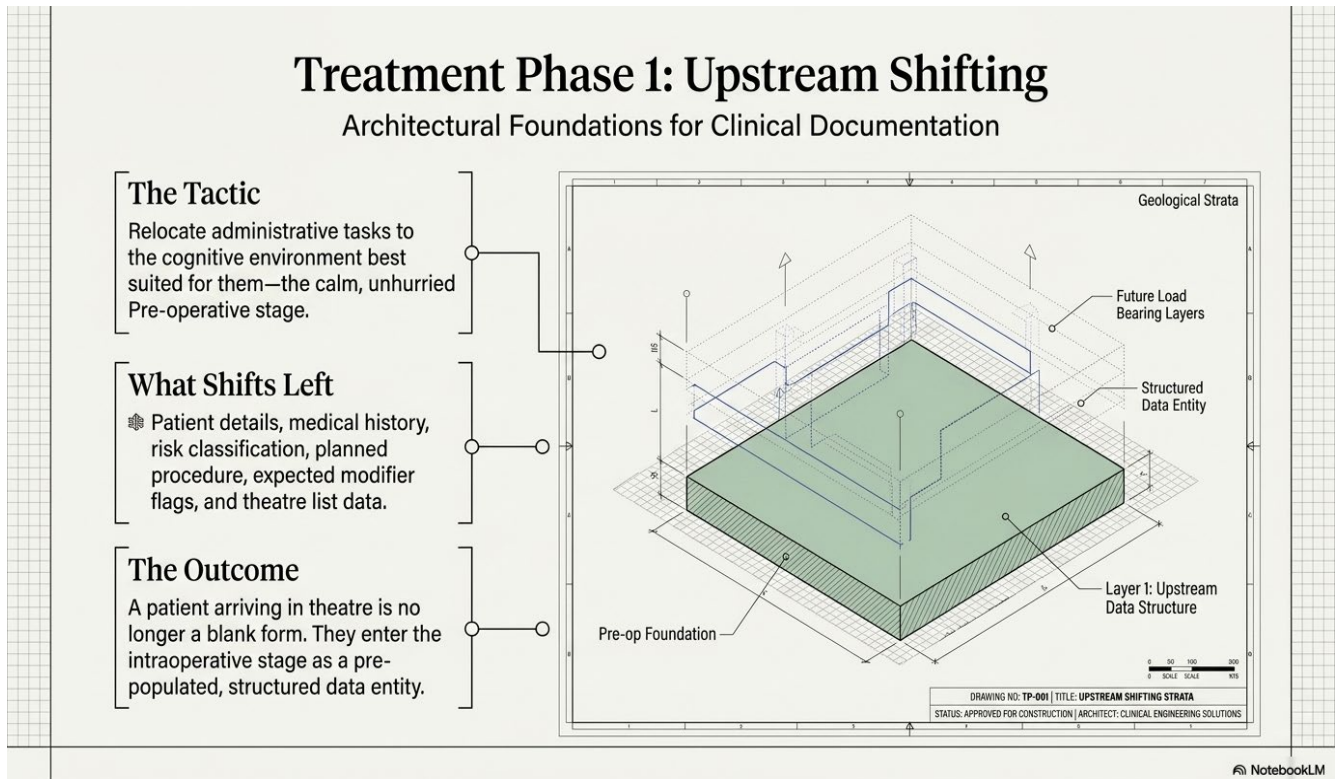
Technology does not solve the structural problem. A digital form is still a form. A voice transcription of a retrospective reconstruction is still a reconstruction. What technology can do is make structural redistribution practical. **The seven components below describe a system in which technology enables the structural solution rather than substituting for it.**

#### Component 1

#### Load Redistribution Across the Three Stages

Documentation tasks should be deliberately assigned to the stage best suited to handle them. Pre-operative capture should handle patient details, history, risk classification, planned procedure, and consent, in a calm environment without

clinical demands. The intraoperative stage should be reserved for what genuinely cannot be captured elsewhere: clinical milestones, events, and decisions as they occur. Post-operative review should be a confirmation of a substantially complete record, not reconstruction from memory. The anaesthesiologist's intraoperative cognitive attention is never loaded with work that belongs at another stage.



### Component 2

#### Information Continuity

Information captured at any stage travels forward automatically to every subsequent stage. The theatre list should feed the pre-operative record. The pre-operative record should feed the intraoperative companion. The intraoperative record should feed the post-operative review and the billing output. Nothing is re-entered. Nothing is asked twice. The case should be treated as a single unified record that accumulates progressively from the moment the patient appears on the theatre list to the moment the billing submission is approved.

### Component 3

#### Event-Driven system

The system should be built around a defined clinical events model that reflects how anaesthesia actually works. It should not present as a blank form. The system should present the right clinical events, in the right sequence, at the right stage. The events should be pre-defined by domain expertise: induction, nerve block, positioning, ultrasound guidance, time milestones, drug administration, complications. The doctor should record clinical reality. The system should structure it. The event model should be the bridge between what happens in the theatre and what the billing and medico-legal record requires.

### Component 4

## **Guided Workflow and Proactive Prompting**

The system should not wait for the doctor to remember. It should guide him through the case in sequence, surfacing what is missing and prompting for what should have been captured by then. This is the checklist function, embedded in the workflow rather than imposed on top of it. The prompts should be context-aware: they should appear at the right moment in the right stage, based on what the event model expects. The doctor should never be faced with a blank form and an expectation to populate it from memory. He should be guided through a structured sequence that matches the clinical reality he is already living.

### **Component 5**

#### **Passive Automation**

Certain data should be captured without any active input from the doctor. Photo capture of the anaesthetic monitor records physiological data automatically. Voice notes capture clinical observations in the doctor's own words without requiring translation into administrative language under pressure. Time stamps are applied automatically at defined clinical milestones. The passive layer reduces the active documentation burden to the irreducible minimum: the events and decisions that genuinely require the doctor's conscious input and nothing else.

### **Component 6**

#### **Clinical Intelligence: Separating Capture from Translation**

The most technically demanding component is the separation of clinical capture from billing translation. In the current model, the doctor must simultaneously perform the clinical procedure, record what is happening, and translate the clinical record into billing language, applying modifier rules, procedural dominance logic, and tariff-specific coding conventions under time pressure. The solution separates these functions explicitly. The doctor records clinical reality. A rules-based intelligence engine, built on deep knowledge of the South African tariff framework, NHRPL modifier hierarchies, and SASA coding guidelines, should translate that clinical record into deterministic billing output automatically. The doctor should never need to think about billing codes. The engine should.

### **Component 7**

#### **Completeness Enforcement**

The system should verify completeness against the clinical event model before the record is finalised. Nothing should be submitted with gaps that the doctor has not consciously reviewed and confirmed. This is the checklist principle applied to documentation: the structured workflow enforces a standard of completeness that memory and manual processes cannot reliably achieve. The result is a record that is not merely filled in but verified, not merely submitted but defensible. The medico-legal and billing functions of the record are then both served by the same completeness standard.

## **Conclusion**

The argument of this paper is straightforward. The documentation problem in anaesthesia is not a behavioural problem. It is a structural one. It has persisted not because practitioners are careless or tools are scarce, but because no

available solution has addressed the full structure of the problem simultaneously.

The seven components described in Part 5 are not a wish list. They are a precise response to a precisely diagnosed structural flaw. Load redistribution addresses the cognitive mismatch between when documentation occurs and when it should occur. Information continuity addresses fragmentation. Event-driven capture and guided workflow address the absence of clinical structure in existing tools. Passive automation reduces the intraoperative burden to its irreducible minimum. Clinical intelligence separates what the doctor should do from what the system should do. Completeness enforcement ensures that the record that emerges is defensible, not merely filled in.

The problem is old. The diagnosis is clear. The components of the solution have been defined. What has been missing is their assembly into a single integrated product built for the specific conditions of the South African private theatre environment.

*The authors welcome correspondence from anaesthesiologists, procedural specialists, practice managers, and medical aid administrators with an interest in the documentation challenge described in this paper.*

*A follow-up publication will describe the practical implementation of the structural solution in the South African private theatre environment.*

# References

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## Clinical Research — Anaesthesia Documentation and Workload

1. Weinger MB, Herndon OW, Gaba DM. The effect of electronic record keeping and transesophageal echocardiography on task distribution, workload, and vigilance during cardiac anesthesia. *Anesthesiology*. 1997;87(1):144–155. doi:10.1097/00000542-199707000-00019
2. Tse MK, Li SYW, Chiu TH, Lau CW, Lam KM, Cheng CPB. Comparison of the effects of automated and manual record keeping on anesthetists' monitoring performance: randomized controlled simulation study. *JMIR Human Factors*. 2020;7(2):e16036. doi:10.2196/16036
3. Devitt JH, Rapanos T, Kurrek M, Cohen MM, Shaw M. The anesthetic record: accuracy and completeness. *Canadian Journal of Anaesthesia*. 1999;46(2):122–128. doi:10.1007/BF03012545
4. Gaba DM, Lee T. Measuring the workload of the anesthesiologist. *Anesthesia & Analgesia*. 1990;71(4):354–361. doi:10.1213/00000539-199010000-00006
5. Weinger MB, Reddy SB, Slagle JM. Multiple measures of anesthesia workload during teaching and nonteaching cases. *Anesthesia & Analgesia*. 2004;98(5):1419–1425. doi:10.1213/01.ANE.0000106838.66901.D2
6. Slagle JM, Weinger MB. Effects of intraoperative reading on vigilance and workload during anesthesia care in an academic medical center. *Anesthesiology*. 2009;110(2):275–283. doi:10.1097/ALN.0b013e318194b1fc
7. Leedal JM, Smith AF. Methodological approaches to anaesthetists' workload in the operating theatre. *British Journal of Anaesthesia*. 2005;94(6):702–709. doi:10.1093/bja/aei131

## Anesthesia Information Management Systems (AIMS)

8. Stol IS, Ehrenfeld JM, Epstein RH. Technology diffusion of anesthesia information management systems into academic anesthesia departments in the United States. *Anesthesia & Analgesia*. 2014;118(3):644–650. doi:10.1213/ANE.0000000000000055
9. Muravchick S, Caldwell JE, Epstein RH, et al. Anesthesia information management system implementation: a practical guide. *Anesthesia & Analgesia*. 2008;107(5):1598–1608. doi:10.1213/ane.0b013e31818187bc8f
10. Kadry B, Feaster WW, Macario A, Ehrenfeld JM. Anesthesia information management systems: past, present, and future of anesthesia records. *Mount Sinai Journal of Medicine*. 2012;79(1):154–165. doi:10.1002/msj.21281
11. Sanborn KV, Castro J, Kuroda M, Thys DM. Detection of intraoperative incidents by electronic scanning of computerized anesthesia records: comparison with voluntary reporting. *Anesthesiology*. 1996;85(5):977–987. doi:10.1097/00000542-199611000-00004

## Human Factors and Cognitive Performance

12. Gaba DM, Fish KJ, Howard SK. *Crisis Management in Anesthesiology*. Churchill Livingstone; 1994.
13. Cook RI, Woods DD. Operating at the sharp end: the complexity of human error. In: Bogner MS, ed. *Human Error in Medicine*. Lawrence Erlbaum Associates; 1994.
14. Reason J. *Human Error*. Cambridge University Press; 1990.
15. Kahneman D. *Thinking, Fast and Slow*. Farrar, Straus and Giroux; 2011.
16. Gawande A. *The Checklist Manifesto: How to Get Things Right*. Metropolitan Books; 2009.

## Theory of Constraints and Operations Management

17. Goldratt EM, Cox J. The Goal: A Process of Ongoing Improvement. North River Press; 1984.
18. Goldratt EM. The Theory of Constraints. North River Press; 1990.
19. Silvester K, Lendon R, Bevan H, Steyn R, Walley P. Reducing waiting times in the NHS: is lack of capacity the problem? Clinician in Management. 2004;12(3):105–111.

## South African Healthcare and Billing Framework

20. South African Society of Anaesthesiologists (SASA). Private Practice and Coding Guidelines 2021. SASA; 2021. Available at: <https://sasaweb.com/wp-content/uploads/2024/06/SASA-Private-Practice-Coding-Guidelines-2021.pdf>. Accessed May 2026.
21. Council for Medical Schemes (CMS). National Health Reference Price List materials and related historical tariff documentation. Available at: [medicalschemes.co.za](https://medicalschemes.co.za). Accessed May 2026. Note: Current tariff guidance for private practice should be obtained directly from the Board of Healthcare Funders (BHF) or the South African Society of Anaesthesiologists (SASA) coding guidelines, as the NHRPL is not a currently maintained annually updated tariff reference.

## Products and Systems Referenced in Part 5

22. Microsoft / Nuance. Dragon Medical One: Clinical Speech Recognition Platform. Available at: <https://www.nuance.com/healthcare/dragon-ai-clinical-solutions/dragon-medical-one.html>. Accessed May 2026.
23. Heidi Health. Heidi: AI Care Partner for Clinical Documentation. Available at: <https://www.heidihealth.com>. Accessed May 2026.
24. Healthbridge. MxNode Anaesthesia Application: Digital Anaesthesia Record Keeping for Private Practice. Available at: <https://www.healthbridge.co.za>. Accessed May 2026. Note: For specific product documentation, contact Healthbridge directly at [healthbridge.co.za](https://www.healthbridge.co.za).
25. Alchemed. Alchemed Practice Management Software. Available at: <https://www.alchemed.com>. Accessed May 2026. Note: For specific anaesthesia module documentation, contact Alchemed directly.
26. Provation Medical. Provation iPro: Cloud-based Anesthesia Information Management System. Available at: <https://www.provationmedical.com/ipro-anesthesia/>. Accessed May 2026.
27. Picis Clinical Solutions. Anesthesia Manager: Perioperative Clinical Information System. Available at: <https://www.picis.com>. Accessed May 2026.
28. iMDsoft. MetaVision Anesthesia Information Management System. Available at: <https://imdsoft.com/metavision/anesthesia/>. Accessed May 2026.
29. GoodX. GoodX Practice Management Software. Available at: <https://www.goodx.international>. Accessed May 2026.