

What we see in the operating room

Two specialties. Two windows. One trajectory.

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What the operating table witnesses

The incision opens more than anatomy. It exposes the biological record of everything that came before.

Coronary quality	Myocardial texture	Aortic burden	Systemic signals
• Diffuse calcification beyond the planned anastomosis • Heavily diseased distal runoff — the target exists on the angiogram but not in the field • Each finding is a decade of metabolic history made visible	• The feel of a hypertrophied ventricle under the fingers: stiff, oxygen-hungry, unforgiving • Fibrotic patches mapping old silent infarctions no one documented • The contractility we restore at reperfusion reflects the reserve that remained	• Porcelain aorta: clamping site selection becomes the operation's central problem • Atheroma at the clamp site: embolic risk made tactile • A summary of systemic vascular age that no imaging study fully conveyed	• Muscle wasting visible on opening: sarcopenia is not an abstraction in this room • Friable tissues, poor healing substrate: the nutritional reserve the patient arrived with • None of this was captured in the preoperative workup

What the operating table witnesses

“By the time a patient reaches the operating table, the trajectory has already run.”

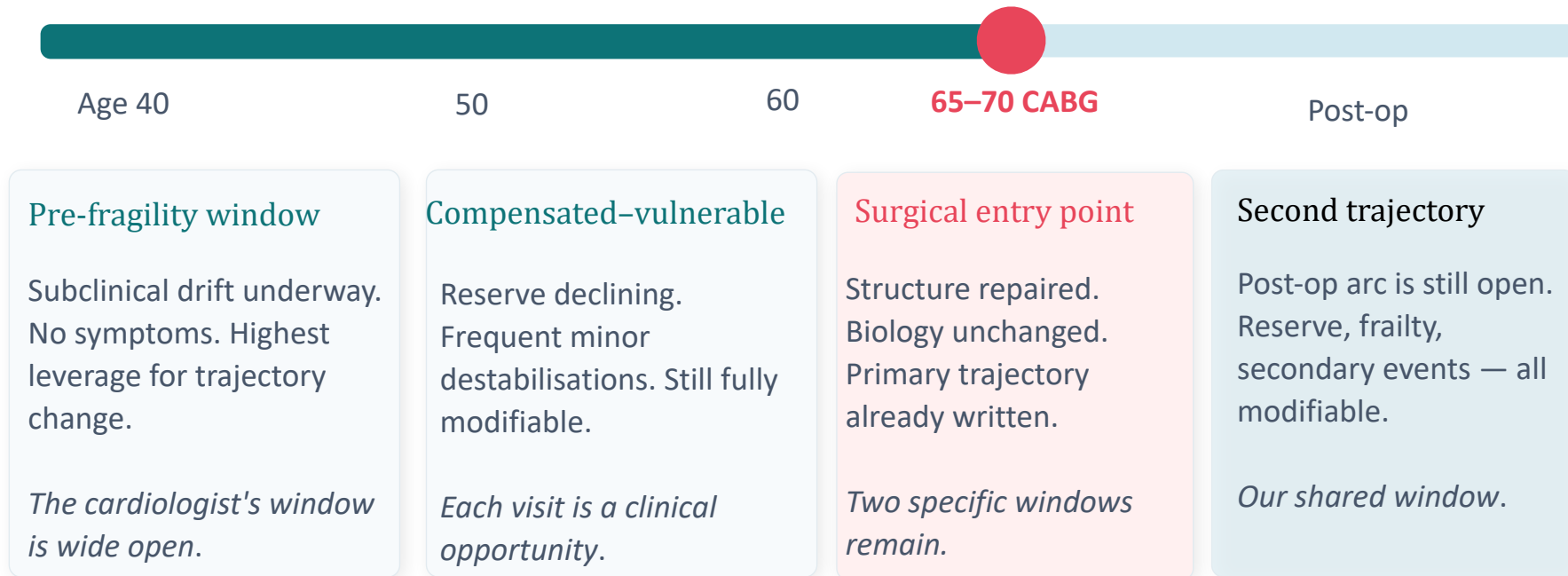
The structure we repair

Cardiac surgery operates at the endpoint of cardiovascular disease. We restore anatomy — coronary bypasses ,valves, aorta. The operation is technically successful.

The history we cannot undo

Decades of metabolic drift, deconditioning, inflammation, and genetic vulnerability arrived with the patient. The knife cannot reach that history.

The trajectory — and when it becomes visible



Five domains of physiological reserve — where the system is going

Exercise capacity

-23% CV mortality

150 min/wk aerobic + 2× strength (BMJ 2025)

-15% CV mortality / MET (JAMA 2009)

Muscle reserve

-17% CV mortality per 5 kg grip

Stronger predictor than systolic BP
(PURE, n=139,691, Lancet 2015)

Sleep quality

12–14% attr. CV mortality

AHA Life's Essential 8, 2022

Drives inflammatory & autonomic pathways

Nutrition

Metabolic environment

Shapes inflammation, microbiome,
pharmacogenomic response

Social connectedness

2.9× post-MI mortality

Social isolation: 29–32% ↑ CHD/stroke (AHA 2022)
Neuroendocrine pathway — not a soft variable

The cardiologist's edge: reading velocity, not values

The same number can represent stability — or alarming decline. The direction matters more than where the curve sits today.

Grip strength

42 kg

Cross-section only:

Within normal range — no action

With trajectory:

42 kg ↓ from 52 kg over 18 months
→ active systemic reserve loss

VO₂max

32 ml/kg/min

Cross-section only:

Adequate for age — reassurance

With trajectory:

32 ↓ from 38 over 24 months → 18%
decline = cardiovascular event in slow
motion

CRP

2.1 mg/L

Cross-section only:

'Within normal limits' — filed
hs – CRP?

With trajectory:

2.1 ↑ from 0.6 over 3 visits →
threefold rise in inflammation, invisible
to threshold reading

PESA cohort (JACC 2021): subclinical atherosclerosis progression in 32.7% of healthy middle-aged adults over 6 years — no symptoms, no diagnosis.

The apparently well patient: medicine's unsolved consultation

They feel well. Their tests are 'normal'. They have no reason to attend to a trajectory they cannot feel.

Show the gap, not the risk

A VO_2max of 32 ml/kg/min at age 47 corresponds to the cardiovascular fitness of a 58-year-old.

Not a warning — a mirror. Most people act on a mirror before they act on a statistic.

Reserve as margin of safety

Not 'you are at risk' but 'your buffer against future stress is contracting.'

Engineers and pilots understand this framing better. Reserve is the distance from where you are to the threshold — and it is shrinking.

The trajectory is reversible — from now on

Pre-frailty reversal in 18–87% with targeted intervention. VO_2max gains of 15–20% in 12 weeks.

The direction can be changed — but only while the window is open.

Patient as co-observer

'Here is where your grip strength was 18 months ago. Here is where it is now. What do you want to do with that?'

Enrolment in the observation might change the relationship.

The surgeon's first window: before the incision

The mean CABG patient is 65–70. Decades of drift have already run. But between the decision to operate and the incision, there is a window.

Risk dialogue — informed surgical consent

The preoperative discussion is not administrative. It is the moment when the patient first understands that their biological state — not just their anatomy — determines outcome.

Frailty, reserve, comorbidity burden: all modify operative risk and all can be communicated honestly. This conversation creates an opportunity for active participation in recovery before the operation has begun.

Prehabilitation — the modifiable window

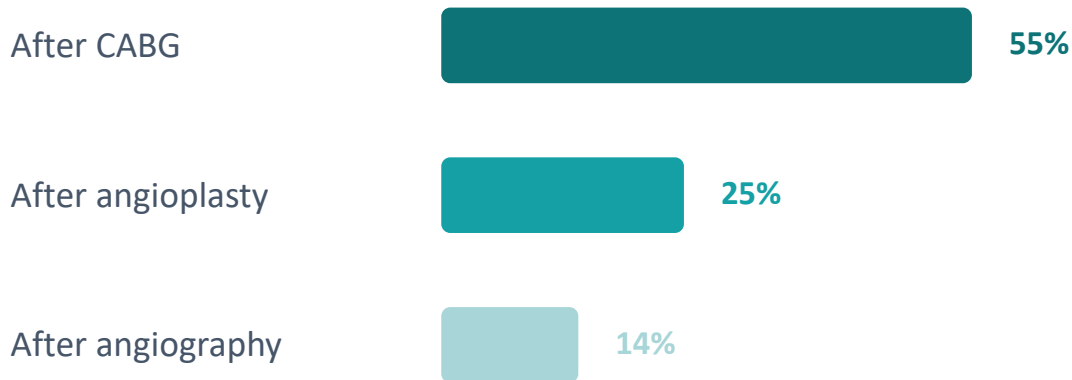
Even 2–4 weeks of structured light exercise before elective cardiac surgery improves postoperative pulmonary function, reduces ICU stay, and accelerates functional recovery.

Metabolic and nutritional optimization are other levers. Frailty, sarcopenia and metabolic disarray are the strong independent predictors of adverse outcomes — and they respond to intervention.

The surgeon's second window: after surgery

The surgical encounter creates an intensity of reflection no office visit can replicate. It is one of the strongest teachable moments in cardiovascular medicine.

Smoking cessation at 1 year — the fourfold gradient:



EUROASPIRE V (8,261 pts, 27 countries, 6 months post-event): 66% physically inactive · 38% obese · 55% of pre-event smokers still smoking.

The teachable moment is not being used.

Using the window

- Name the trajectory — explicitly — before discharge
- Encourage rehabilitation & post rehab exercise
- Schedule the reserve audit at 3, 6, 12 months
- Frame recovery as the beginning of the second trajectory
- Connect to the cardiologist's follow-up programme

The physiological reserve audit

Assessment

- Grip strength (dynamometer)
- Sit-to-stand (5 times)
- Gait speed (5-meter walk)
- Sleep quality (PSQI)
- Social connectedness (UCLA brief)
- Metabolic panel (glucose metabolism, (hs)CRP, total proteins / albumin –under current investigation: antioxidative status)
- Anxiety evaluation (psychologist)

What each of us can — and cannot — do alone

	Cardiologist	Cardiac Surgeon
When they meet the patient	Age 40–65 — trajectory modifiable	Age 65–70 — trajectory already written
What they can redirect	The primary arc — decades of compounding drift	Cannot undo the primary arc
First window	Every consultation — the longitudinal relationship	Preoperative discussion + prehabilitation
Second window	Post-event secondary prevention	Post-op teachable moment — the most intense in medicine
What neither can do alone	Deliver trajectory medicine across both arcs	Deliver trajectory medicine across both arcs

Teaching clinicians to think in time (trajectories)

The upstream argument is ultimately a curriculum argument. What we teach shapes what gets seen in the consultation room — and what gets acted upon.

What most curricula teach

- Disease entity by disease entity
- Threshold-based pattern recognition
- Health as background, disease as figure
- Cross-sectional reasoning
- Optimised for the event — not for what preceded it.

What USI is doing (symptom-oriented)

- Organised around clinical presentations, not disease labels
- Dissolves specialty silos from year one
- Students reason from patient biology
- A meaningful step. Still cross-sectional.

What trajectory thinking adds

- Teaching students to think in time frames
- Where is the system going — not just what symptom is it producing
- Physiological reserve, velocity, leverage points
- The clinician who delivers this can change lives

BMJ (2025): Few clinicians receive formal training in the biology of ageing, interpreting age-related biomarkers, or evaluating evidence of longevity interventions. The gap is documented and system-wide.

What we see in the operating room is the bill for everything that happened before.

- The operation repairs the structure. It cannot undo the biological history.
- But two windows remain — and together they are enough to change the outcome of the second trajectory.

The cardiologist's window

The consultation room. The longitudinal relationship. The trajectory before the event.
Still wide open at 50.

The surgeon's two windows

Before the cut: risk dialogue and prehabilitation.
After the cut: the most intense teachable moment in medicine.

Thank you for your attention!

