COMPETENCY AND PROFICIENCY IN ROBOTIC CORONARY SURGERY: A META-ANALYSIS OF LEARNING CURVES

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BACKGROUND

Robotic-assisted coronary artery bypass grafting (RA-CABG) is technically complex, and the case volume required to achieve competent and proficient performance remains uncertain. Individual learning curve reports are heterogeneous and lack quantitative synthesis.

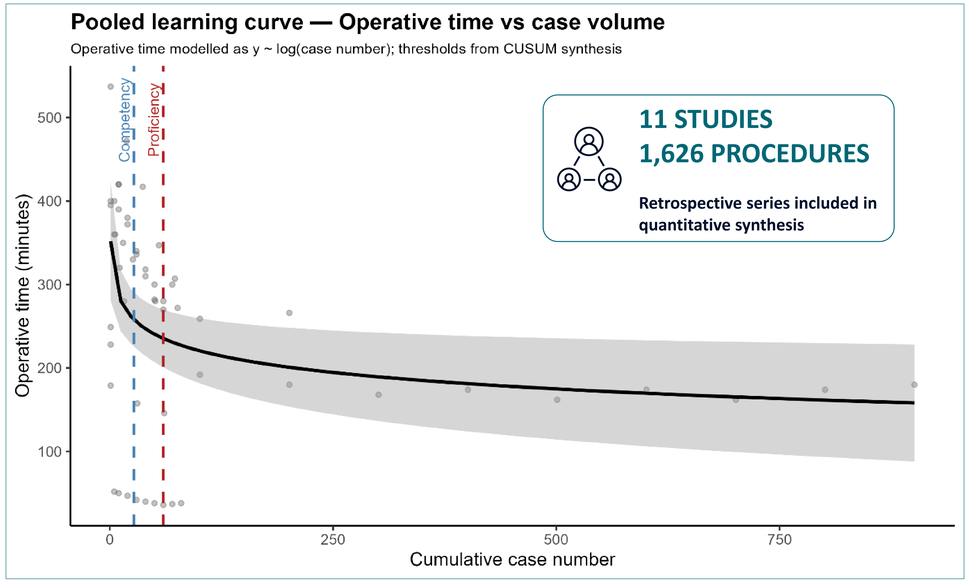
METHODS

- **Published studies** reporting sequential operative time data for RA-CABG or totally endoscopic coronary artery bypass were synthesised.
- **Operative times were harmonised into a sequential** framework, preserving case order.
- Within-study learning transitions were analysed using the cumulative sum (CUSUM) methodology with study-specific late-phase operative time targets. Change-point analysis identified thresholds for competency (d1) and proficiency (dz).
- A pooled learning curve was constructed using **mixed-effects meta-regression of operative time** against cumulative case number.

OBJECTIVE

To quantitatively define the learning curve for RA-CABG and establish evidence-based case volume thresholds for competency and proficiency using pooled operative time data from the published literature.

POOLED LEARNING CURVE



RESULTS

Eleven retrospective studies comprising **1,626** CABG procedures were included.

Operative time **CUSUM** curves demonstrated a consistent early learning phase followed by efficient improvement across studies.

The pooled learning curve showed a steep early reduction in operative time with progressive attenuation of gains.

KEY LEARNING THRESHOLDS

27 CASES | **COMPETENCY THRESHOLD (d_1)**

Median case number to achieve competent performance
(IQR 25 – 82)

60 CASES | **PROFICIENCY THRESHOLD (d_2)**

Median case number to achieve proficient performance
(IQR 54 – 200)

Steep early reduction in operative time with **progressive attenuation of gains**, confirming a **reproducible transition** from **early learning to competent** and subsequently **proficient** performance.

Conclusion

- ✓ Competency in RA-CABG is typically achieved after approximately 25-30 cases.
- ✓ Progression to proficiency requires substantially greater experience, commonly exceeding 60 cases.
- ✓ These findings provide quantitative benchmarks to guide training, programme development, and early credentialing in robotic coronary surgery.