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Editorial

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The growth of robotic surgery: from novelty to necessary infrastructure

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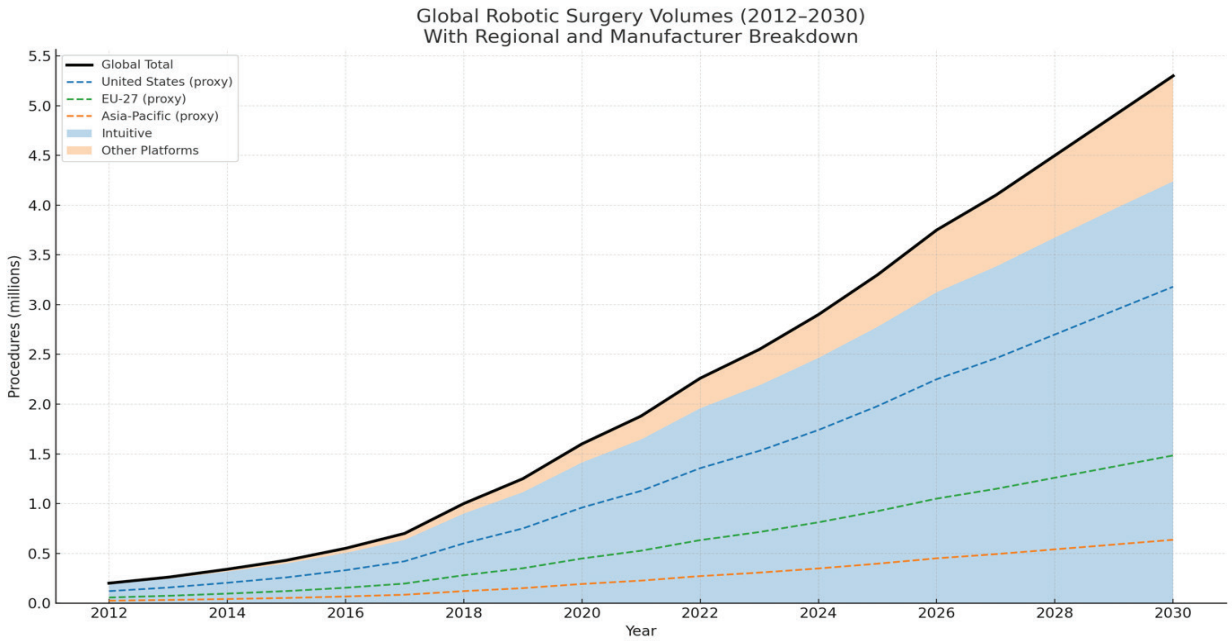
Introduction

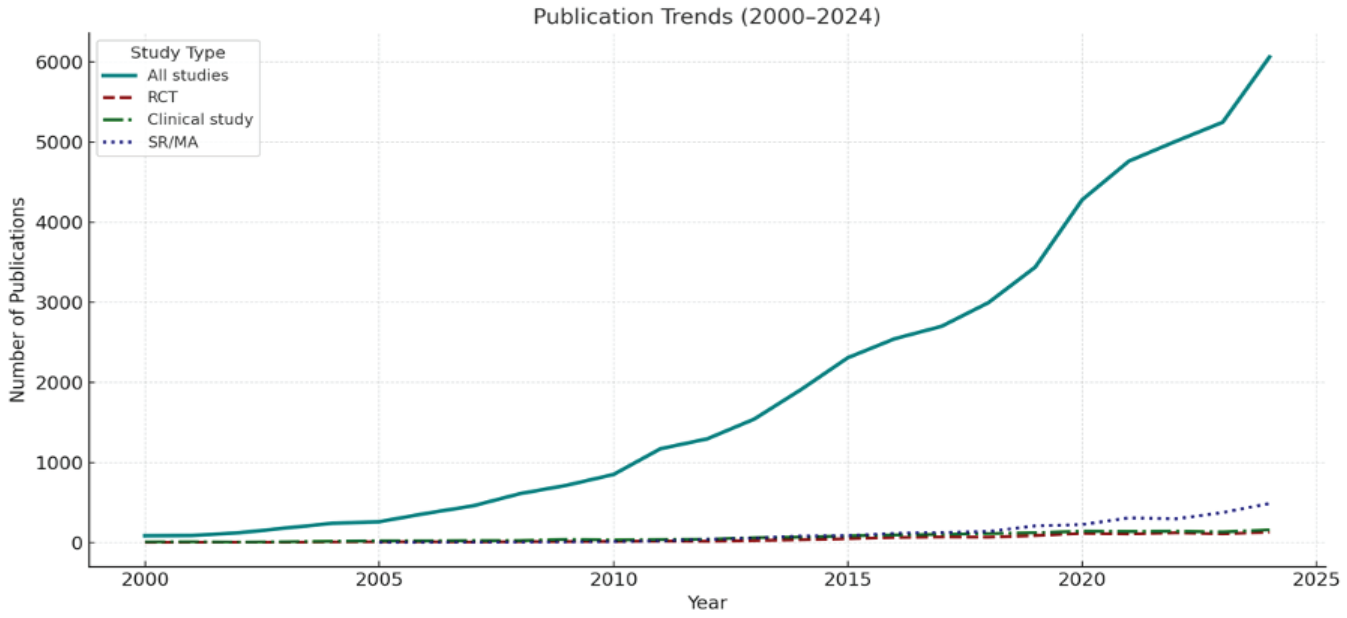
Robotic-assisted surgery has now progressed beyond early adoption, and across the world is moving from niche to mainstream. Best estimates (from aggregated counts and independent forecasts) suggest compound annual growth of about 11-15% through to 2030, at least. The United States, the EU-27 and APAC (Asia-Pacific) all show rising utilisation with similar trajectories (figure 1). Manufacturer dynamics are also shifting, with Intuitive's share easing from about 95% in 2012 to roughly 80% by 2030. In England, robot-supported procedures increased from fewer than 7,000 in 2014 to over 70,000 in 2023/24, and national targets are now for around 500,000 operations per year by 2035[1-3]. The policy question has shifted from whether to integrate robotics to how to scale safely, equitably, and cost-effectively,

Figure 1: Estimated global robotic surgery volumes, 2012-2030



Regional Trends (US, EU-27, APAC) and Manufacturer Breakdown (Intuitive vs Other Platforms). Data are derived from reported procedure volumes, regional market share estimates, and published forecasts projecting 11-15% annual growth through 2030. Regional lines (US, EU-27, APAC) are proxies, and manufacturer share reflects Intuitive's historical dominance (approximately 95% in 2012, declining to ~80% by 2030). Figures represent global robotic procedures across all indications; installation counts and hard/soft-tissue splits are not shown. See Supplement for more details.

Figure 2: Publication trends for the term “robotic surgery” for 2000-2024.



all whilst generating decision-ready evidence[4]. Early Value Assessment guidance from the UK’s NICE has firmly linked conditional recommendations to structured evidence generation[5].

Soft-tissue robotics has been led for two decades by visionary change through the da Vinci system, for which we have much to be appreciative. Intuitive reported 2024 revenue of US$8.35 billion (17% year-on-year), with 84% derived from recurring sources, reflecting procedure growth and consumable use[6]. Many new entrants are now providing procedure specific alternatives. CMR’s modular Versius platform has regulatory clearance in major markets and is now in routine clinical use, with more than 30,000 procedures reported across over 30 countries[7,8]. Johnson & Johnson’s OTTAVA system has completed its first clinical cases within a formal trial, marking the beginning of human use[9]. Medtronic’s Hugo robotic assisted surgery platform has expanded its European offering following CE mark approval for the LigaSure vessel sealing instrument, extending its role in gynaecological, general and urological procedures[10]. Alongside these systems, a growing number of soft tissue robots from global manufacturers are entering development and early clinical use, marking a shift towards a future competitive robotic surgery market.

In orthopaedics, diffusion has been equally impressive. Stryker’s Mako platform has exceeded one million procedures in 35 countries, while Zimmer Biomet’s ROSA and Globus Medical’s ExcelsiusGPS continue to expand indications and installed base[11-13]. Meta-analyses suggest improvements in radiographic alignment and outlier reduction after robotic knee arthroplasty, though consistent gains in function or revision rates remain uncertain, identifying the need for long-term comparative data[14,15].

The literature base is expanding across specialties but remains dominated by case series and single-centre cohorts rather than multicentre randomised trials (figure 2). Landmark trials, including ROLARR for rectal cancer and LACC for cervical cancer illustrate the challenges of conducting pragmatic surgical trials in the context of learning curves and evolving systems[16,17]. Orthopaedic trials and systematic reviews continue to mature but have not yet delivered uniform clinical superiority, despite gains in precision[14,15].

We use the terms robotic plurality, or multiplatform robotics, to describe service models in which teams train and practice across multiple platforms within a health system, enabling vendor competition, reducing over-dependence on a single supplier, and supporting

platform-agnostic curricula. Plurality can facilitate procurement efficiency and resilience, while allowing modular, lower-footprint systems to extend access where capital constraints prevent flagship installations. For plurality to deliver value, three conditions are necessary: interoperable data allowing comparative outcomes across platforms; competency-based training and credentialling that are portable between systems; adaptive technology assessments responsive to iterative hardware and software upgrades.

Equity considerations are important to the future for both providers and governments. Billions lack access to safe surgical care, and without explicit attention to equity, robotics risks deepening disparities between and within countries. Public systems in low- and middle-income settings face capital and maintenance barriers; adoption for robotics has clustered in private urban hospitals. Pragmatic models, such as lower-cost robots, digital laparoscopic assistants, and adjuncts for open surgery, could support equitable technology access if specified for maintainability, local technical support, and total cost of ownership. International collaborations should prioritise platform-agnostic training, open data standards, and outcomes that matter to patients, not only throughput[18].

Investment in robotics is typically described alongside opportunity costs versus alternative capital projects and service delivery, although these costs might be smaller than expected and may not exist at all if the benefits are delivered. Industry and health systems should develop decision-grade evidence on outcomes, costs, and wider benefits. NICE's conditional approvals provide a lever to align reimbursement with real-world evidence generation. More will be achieved if industry and research organisations work together to accelerate comparative effectiveness research.

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