

INPLASY

INPLASY2026100011

doi: 10.37766/inplasy2026.10.0011

Received: 2 October 2026

Published: 2 October 2026

Corresponding author:

Serhat Sen

serhatsen8@gmail.com

Author Affiliation:

Department of Gynecologic
Oncology, Istinye University Faculty
of Medicine, Liv Hospital Topkapı,
Istanbul, Türkiye.

Learning phases and operative time in robotic gynecologic surgery: protocol for an aggregate-data meta-analysis of phase definitions and reported case experience

Sen, S; Sen, FG.

ADMINISTRATIVE INFORMATION

Support - No support.**Review Stage at time of this submission** - Data analysis.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY2026100011

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 2 October 2026 and was last updated on 2 October 2026.

INTRODUCTION

Review question / Objective Among patients undergoing robotic gynecologic surgery, how does source-defined operative time differ between earlier and later phases of the same procedure?

The primary objective is to estimate the later-minus-earlier mean difference in operative time across chronological case blocks or experience periods. Secondary objectives are to examine whether estimates differ when phase boundaries are derived from the observed time trajectory, assess time change per increment in reported case experience where consecutive case positions are available, and synthesize directly measured hospital costs across program phases.

The population comprises patients undergoing robotic gynecologic procedures for benign, oncologic or pelvic-floor indications. The exposure is a later phase of surgeon, team or institutional

experience, and the comparator is an earlier phase of the same robotic procedure.

Rationale Earlier-later comparisons are commonly used to describe learning in robotic surgery, but they represent different amounts and types of experience. A contrast between consecutive case blocks is not equivalent to a comparison separated by several years. Furthermore, selecting phase boundaries from the operative-time trajectory may affect the estimated difference.

This meta-analysis distinguishes phase construction from reported case exposure. It quantifies within-robotic operative-time differences and evaluates whether available data support an experience-based denominator. Direct hospital-cost observations provide a complementary assessment of resource use without converting time differences into assumed financial savings.

Condition being studied The study concerns the acquisition and accumulation of operative

experience in robotic gynecologic surgery. Eligible clinical settings include hysterectomy, myomectomy, gynecologic cancer surgery and pelvic-floor procedures performed with robotic assistance. The outcomes of interest are operative duration and directly measured hospital costs during earlier and later phases of surgical practice.

METHODS

Search strategy The search archive includes PubMed, PubMed Central, Scopus, Web of Science, CENTRAL, SciELO, TR Dizin and Chinese Journal Web (CCJ). Searches combined robotic-platform and gynecologic-procedure concepts, with additional queries addressing learning curves, experience, volume, costs and training. The principal export archive is dated 28 September 2026, with supplementary candidate checks completed on 1 October 2026. Available database-specific search expressions are retained in the accompanying search files.

The principal PubMed expression was:

((robot*[tiab] OR "da Vinci"[tiab] OR daVinci[tiab] OR Hugo[tiab] OR Versius[tiab] OR Senhance[tiab] OR Hinotori[tiab] OR Toumai[tiab] OR KangDuo[tiab] OR "Revo-i"[tiab] OR "Micro Hand"[tiab] OR "MicroHand"[tiab]) OR ("Robotic Surgical Procedures"[Mesh] OR "Robotics"[Mesh])) AND (((gynecol*[tiab] OR gynaecol*[tiab] OR urogynecol*[tiab] OR urogynaecol*[tiab] OR hysterectom*[tiab] OR myomectom*[tiab] OR trachelectom*[tiab] OR sacrocolpopex*[tiab] OR sacrocolpo*[tiab] OR sacrocervicopex*[tiab] OR sacrohysteropex*[tiab] OR colpox*[tiab] OR hysteropex*[tiab] OR vaginectom*[tiab] OR vulvectomy*[tiab] OR oophorectom*[tiab] OR salpingectomy*[tiab] OR ovarian[tiab] OR ovary[tiab] OR ovaries[tiab] OR adnex*[tiab] OR uterine[tiab] OR uterus[tiab] OR endometr*[tiab] OR endometriosis[tiab] OR "cervical cancer"[tiab] OR "cervical carcinoma"[tiab] OR "cervical neoplasm*" [tiab] OR "pelvic organ prolapse"[tiab] OR "pelvic floor"[tiab]) OR vagin*[tiab] OR vulv*[tiab] OR colposacro*[tiab]) OR ("Gynecologic Surgical Procedures"[Mesh] OR "Genital Diseases, Female"[Mesh] OR "Gynecology"[Mesh]))

A complementary PubMed expression addressed surgical volume and training:

((hysterectom*[tiab] AND (surgeon*[tiab] OR provider*[tiab]) AND (volume*[tiab] OR caseload*[tiab] OR "case load*" [tiab])) OR ((urogynecol*[tiab] OR urogynaecol*[tiab] OR "female pelvic medicine"[tiab]) AND (resident*[tiab]

OR fellow*[tiab] OR residenc*[tiab]) AND (train*[tiab] OR curricul*[tiab] OR competenc*[tiab]))).

Participant or population Patients undergoing robotic gynecologic surgery for benign disease, gynecologic malignancy or pelvic-floor disorders. Eligible comparisons may represent individual surgeons, surgical teams or institutional programs. Procedure-specific data are retained separately when a report includes different operations or robotic platforms.

Intervention The exposure is the later phase of experience with a specified robotic gynecologic procedure. Phases may be defined by chronological case blocks, calendar periods, surgeon-experience intervals or outcome-derived boundaries. Chronological and experience-period contrasts form the primary analysis; outcome-derived contrasts are assessed separately.

Comparator The earlier phase of the same robotic gynecologic procedure within the corresponding surgeon, team or institutional series. Comparisons solely between robotic and nonrobotic surgical routes do not contribute to the primary phase-time meta-analysis.

Study designs to be included Prospective or retrospective observational cohorts and consecutive surgical series reporting earlier and later phases of the same robotic gynecologic procedure. Phase-level arithmetic means, standard deviations and sample sizes are required for the time meta-analysis. Studies reporting directly measured hospital costs across program phases contribute to a separate structured synthesis.

Eligibility criteria Eligible quantitative comparisons require directly reported sample sizes, arithmetic means and standard deviations for source-defined total operative or procedure time in an earlier and a later phase of the same robotic gynecologic procedure. Times reported in hours are converted to minutes.

Median-only summaries, unspecified dispersion, isolated console or docking times, simulation studies and comparisons solely between surgical routes are excluded from the direct-input time pool. Alternative divisions of the same cohort are not entered simultaneously. Related publications are linked to avoid duplicate contributions.

The earliest and latest eligible reported phases are selected, including combined early phases when these constitute the directly reported comparison. Intermediate chronological blocks are retained for

the case-position analysis. Economic reports require directly measured hospital costs across program phases; contextual route comparisons and training studies are considered separately.

Information sources PubMed, PubMed Central, Scopus, Web of Science, CENTRAL, SciELO, TR Dizin and Chinese Journal Web (CCJ), together with supplementary candidate checks and reference-based identification of relevant reports. Primary full texts and their supplementary materials provide the phase-level numerical inputs, timing definitions and appraisal information. Source identifiers and extraction locations are retained in the study data package.

Main outcome(s) The primary outcome is the report-level later-minus-earlier mean difference in source-defined operative or procedure time, expressed in minutes, among chronological or experience-period comparisons. Negative values indicate shorter operative time in the later phase.

The pooled estimate is reported with a 95% confidence interval, between-report variance, I^2 and a 95% prediction interval. Timing boundaries are preserved as defined by each source rather than treating total operative time, console time and docking time as interchangeable. Additional outcomes are:

1. Operative-time differences in reports using outcome-derived phase boundaries and the exploratory association between phase definition and effect size.
2. Change in operative time per 10 reported cases, estimated from consecutive chronological blocks with identifiable case positions.
3. Directly measured hospital costs across program phases, including available cost components, currency, price year, accounting perspective and summary measure.
4. Exploratory differences across procedure families and oncologic versus benign indications.

Case-position slopes describe the reported experience interval and are not interpreted as universal proficiency thresholds.

Additional outcome(s) Additional outcomes are:

1. Operative-time differences in reports using outcome-derived phase boundaries and the exploratory association between phase definition and effect size.
2. Change in operative time per 10 reported cases, estimated from consecutive chronological blocks with identifiable case positions.

3. Directly measured hospital costs across program phases, including available cost components, currency, price year, accounting perspective and summary measure.
4. Exploratory differences across procedure families and oncologic versus benign indications.

Case-position slopes describe the reported experience interval and are not interpreted as universal proficiency thresholds.

Data management Records are managed in a structured workbook and linked analysis files. Bibliographic identifiers and normalized titles support deduplication and report linkage. Serhat assembles the archive and performs initial record selection; Serhat and Feyza evaluate the assessment records, eligibility and extracted data, and reconcile differences.

Extraction retains report identity, procedure, indication, surgeon or program unit, phase definition, sample size, mean, standard deviation, timing boundaries and source location. Appraisal judgments and reasons are stored at item level. The source workbook is preserved, while English-language analysis tables and executable Python code provide reproducible inputs and model outputs.

Quality assessment / Risk of bias analysis

Serhat and Feyza assess the selected analytical phase comparisons using the 11-item 2017 JBI checklist for cohort studies. Each judgment is supported by a reason and a source location. The checklist is applied to the early-late comparison even when the original report is described as a surgical case series. No summed quality score or numerical inclusion threshold is used.

For operative duration, absence of an incident outcome at baseline is not applicable; follow-up items concern availability and completeness of the time measurement. Source-specific reporting concerns are documented and examined through sensitivity analyses.

Certainty in the descriptive experience-time association is assessed using an adapted prognostic-factor GRADE framework, considering risk of bias, inconsistency, indirectness, imprecision and publication bias. This assessment does not grade a causal training intervention or a proficiency threshold.

Strategy of data synthesis For each comparison, the effect is the later-phase mean minus the earlier-phase mean. Sampling variance is

calculated as the sum of SD^2/n for the two phases. Multiple eligible contrasts within a report are averaged before pooling, giving each report one effect estimate. Sampling covariance is set to zero for distinct patient groups.

Report-level effects are pooled using inverse-variance random effects, restricted maximum likelihood and modified Hartung–Knapp confidence intervals, with the variance multiplier bounded below by one. Heterogeneity is summarized using I^2 and between-report variance, and a 95% prediction interval is reported.

Chronological and experience-period contrasts form the primary analysis. Outcome-derived contrasts are synthesized separately and included in an all-report sensitivity analysis. Exploratory meta-regression evaluates phase definition.

For consecutive chronological blocks, weighted regression relates phase mean time to the midpoint of the reported case interval, using n/SD^2 weights. Slopes are expressed per 10 cases and synthesized at report level. A first–last midpoint-based rate provides a sensitivity analysis.

Hospital costs are synthesized by procedure, perspective, currency, price year, accounting scope and summary measure. Incompatible mean and median costs are not pooled, and pooled operative-time differences are not converted into monetary savings.

Subgroup analysis Exploratory analyses examine hysterectomy-family and pelvic-floor procedures, and oncologic versus benign indications. Mixed or unspecified indications are not forced into an indication-specific group. Phase construction is examined through separate chronological and outcome-derived syntheses and report-level meta-regression.

Subgroup findings are interpreted as exploratory associations rather than evidence of comparative clinical safety or causal effect modification.

Sensitivity analysis Sensitivity analyses include:

1. All eligible reports, including outcome-derived phases.
2. Restriction to chronological case blocks.
3. Alternative within-report averaging using inverse-variance weights.
4. Within-report sampling correlations of 0.5 and 1.
5. At least 10 observations in each phase.
6. Leave-one-report-out analyses.
7. Separate omission of Feuer, Gest and Kim.

8. Exclusion of reports with appraisal-related source-clarification recommendations.

9. For case-position estimates, comparison of all-block slopes with first–last midpoint-based rates and omission of Feuer or Lauterbach.

These analyses assess the numerical influence of analytical assumptions, small phases and source-specific reporting concerns.

Language restriction No language restriction was applied to study eligibility.

Country(ies) involved Turkiye.

Other relevant information This is a retrospective registration of a completed, unpublished analysis. Study selection, data extraction, appraisal and statistical analyses preceded registration. The chronological-primary hierarchy, case-position analysis and appraisal-based sensitivities were developed during data review.

The registration documents the analytical methods used. The extracted data, appraisal matrix and reproducible analysis code will be deposited in Zenodo and linked to the registration and manuscript.

Keywords robotic surgery; gynecology; learning curve; operative time; meta-analysis; case experience; hospital costs.

Dissemination plans The findings will be submitted to a peer-reviewed surgical journal and presented at relevant scientific meetings. Extracted aggregate data, the appraisal matrix and reproducible analysis code will be made available through Zenodo. Registration and repository identifiers will be included in the manuscript.

Contributions of each author

Author 1 - Serhat Sen - Conceptualized the study, assembled the search archive, performed initial record selection and statistical analyses, evaluated eligibility and extracted data, contributed to appraisal and interpretation, and drafted and revised the manuscript.

Email: serhatsen8@gmail.com

Author 2 - Feyza Gulgel Sen -Contributed to study development, record assessment, eligibility evaluation, extraction verification, methodological review, critical appraisal, interpretation and manuscript revision.

Email: feyzaa.gulgel@hotmail.com