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BACKGROUND

Gynaecological disorders, including uterine fibroids, endometriosis, pelvic organ prolapse, and various malignancies, represent significant health challenges affecting women globally. According to the World Health Organization (WHO), these disorders substantially impact women's quality of life, fertility, psychological well-being, and overall health. Worldwide, approximately 10% of women suffer from endometriosis, while uterine fibroids affect up to 70% of women by age 50. The prevalence of pelvic organ prolapse and urinary incontinence also rises with advancing age, significantly affecting postmenopausal populations.

In Malaysia, the prevalence of gynaecological disorders mirrors global trends, with uterine fibroids and endometriosis among the most commonly reported conditions in women of reproductive age. Endometriosis affects approximately 10% to 15% of Malaysian women, significantly impacting fertility, work productivity, and healthcare utilization. Similarly, pelvic organ prolapse has increasingly been diagnosed due to an aging population, raising concerns regarding long-term management and resource allocation within the public healthcare system.

Traditionally, gynaecological disorders have been managed through conservative medical treatments, minimally invasive laparoscopic surgery, or open surgery for severe cases. Minimally invasive laparoscopic techniques have become the standard of care due to reduced morbidity, shorter hospital stays, and faster recovery compared to open surgery; however, these approaches remain technically challenging in complex cases.

Robotic-assisted surgery has emerged as an innovative surgical option, offering enhanced visualization, greater precision, and improved ergonomics, particularly in complex gynaecological procedures. Given the promising benefits yet significant costs associated with robotic surgery, the Medical Services Development Section, Ministry of Health (MOH) Malaysia, has requested this technology review to comprehensively evaluate the clinical effectiveness, safety, and cost-effectiveness of robotic surgery for gynaecological disorders. The review aims to provide evidence to guide informed decision-making and justify the potential expansion of robotic surgical services within MOH healthcare facilities across Malaysia.

OBJECTIVE

The objective of this technology review was to assess the effectiveness, safety, and costeffectiveness of robotic-assisted surgery for gynaecological disorders.

METHODS

A systematic search was conducted on the following databases without any restriction on publication language and publication status. The Ovid interface: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily 1946 to March 3rd, 2025. Searches were also run in Cochrane

Embase, PubMed, and INAHTA databases. Google was used to search for additional web-based materials and information. Additional articles were identified by reviewing the references of retrieved articles. The last search was conducted on 3rd March 2025.

RESULTS AND CONCLUSION:
Search results A total of 590 records were identified through the Ovid interface and PubMed while 15 were identified from references of retrieved articles. Thirty-three duplicate references were found; 557 potentially relevant titles were screened using the inclusion and exclusion criteria. Of these, 44 relevant abstracts were retrieved in full text. After reading, appraising, and applying the inclusion and exclusion criteria to the full-text articles, 33 were included while the other 11 were excluded since the studies were included in the systematic reviews, had irrelevant populations and few were narrative reviews. All full-text articles finally selected for this review were 18 systematic review and network meta/meta-analysis, 6 systematic reviews, one HTA, one cohort study, two cross-sectional studies, two qualitative studies, and three cost analyses.

Efficacy/ effectiveness

Robotic-Assisted Surgery for General Gynaecological Disorders
Multiple meta-analyses and systematic reviews demonstrated that robotic-assisted surgery showed comparable effectiveness to conventional laparoscopic and open surgeries for general gynaecological conditions including benign and malignant conditions, with similar clinical outcomes. Although robotic surgery consistently involved longer operative times compared to laparoscopic approaches, it provided notable advantages over open surgery, including reduced length of hospital stay and lower estimated blood loss.

Robotic-Assisted Surgery for Myomectomy
Evidence from systematic reviews and meta-analyses showed that compared to laparoscopic myomectomy and open myomectomy, robotic-assisted myomectomy significantly reduced estimated blood loss, lowered conversion rates from minimally invasive to open surgery, and shortened hospital stays relative to open myomectomy. However, operative times were consistently longer for robotic-assisted myomectomy compared to laparoscopic myomectomy and open myomectomy.

Robotic-Assisted Surgery for Endometriosis
Evidence from systematic reviews and meta-analyses indicates that robotic-assisted surgery demonstrates comparable clinical effectiveness to conventional laparoscopic surgery for endometriosis. Robotic surgery showed no significant difference in intraoperative and postoperative complications, conversion rates, or estimated blood loss compared to conventional laparoscopy. However, robotic-assisted surgery consistently involved significantly longer operative times, with mean differences ranging from 28 to 51 minutes compared to laparoscopic surgery. For bowel deep infiltrating endometriosis, robotic surgery was associated with shorter hospital stays and comparable symptomatic relief, despite increased operative durations.

Robotic-Assisted Surgery for Hysterectomy
Evidence from systematic reviews and meta-analyses indicates that robotic-assisted hysterectomy significantly reduces hospital stays,

blood loss, transfusion rates, and conversion rates compared to laparoscopic and open approaches. Robotic single-site hysterectomy also proved safe and feasible, exhibiting short hospital stays, minimal blood loss, and low conversion rates. Despite slightly longer operative times, RAH and RSSH offer clear clinical advantages, particularly beneficial in cases involving larger uteri or prior abdominal surgeries.

Robotic-Assisted Surgery for Endometrial Cancer
Evidence from multiple systematic reviews and meta-analyses demonstrates that roboticassisted surgery for endometrial cancer offers superior perioperative outcomes compared to laparotomy and conventional laparoscopy, particularly in improving short-term surgical outcomes including significantly reduced blood loss, transfusion rates, and hospital stay, though operative times were longer. While long-term oncologic outcomes such as disease-free and overall survival are comparable across surgical approaches, some studies reported a slight advantage in disease-free survival for robotic-assisted surgery.

Robotic-Assisted Surgery for Sacrocolpopexy in Pelvic Organ Prolapse
Multiple systematic reviews and meta-analyses consistently showed robotic-assisted sacrocolpopexy is associated with less estimated blood loss, lower conversion rates, and high anatomical success, particularly for apical prolapse. Although it often involves longer operative times and higher costs, multiple systematic reviews and meta-analyses confirm that it achieves excellent anatomical outcomes, with cure rates up to 98.6% and low recurrence and reoperation rates.

Robotic-Assisted Surgery for Stress Urinary Incontinence
Robotic-assisted artificial urinary sphincter implantation in women with stress urinary incontinence has shown promising effectiveness in multiple recent studies, with continence rates ranging from 72% to 83% and significant improvements in quality-of-life measures.

Safety Robotic-Assisted Surgery for General Gynaecological Disorders
Multiple systematic reviews and meta-analyses indicate that robotic-assisted gynaecologic surgery demonstrates a safety profile comparable to conventional laparoscopic surgery, with no significant differences in overall complication rates. Robotic single-port procedures show acceptable complication rates, predominantly minor, and rare conversion rates. Mortality rates associated with robotic gynaecologic surgery are extremely low, closely mirroring laparoscopic surgery outcomes. Robotic approaches in oncologic cases specifically resulted in significantly lower blood loss compared to open surgery, without increased complication risks.

Robotic-Assisted Surgery for Myomectomy
Multiple systematic reviews and meta-analyses indicate that robotic-assisted myomectomy has a favourable safety profile, showing comparable complication and transfusion rates to laparoscopic myomectomy. However, compared to open myomectomy, robotic procedures demonstrated significantly lower complication rates, reduced transfusion requirements, and decreased blood loss.

Robotic-Assisted Surgery for Endometriosis
Multiple systematic reviews and meta-analyses indicate that robotic-assisted surgery demonstrates comparable safety outcomes to

conventional laparoscopy for endometriosis. Specifically, no significant differences were observed between robotic and laparoscopic procedures regarding intraoperative complications, postoperative complications, conversion rates to open surgery, or estimated blood loss.

Robotic-Assisted Surgery for Hysterectomy
Multiple systematic reviews and meta-analyses indicate that robotic-assisted hysterectomy is associated with favourable safety outcomes compared to other surgical approaches. Roboticassisted hysterectomy showed significantly fewer complications than open hysterectomy, lower transfusion and conversion rates than laparoscopy, and slightly reduced readmission rates. Robotic single-site hysterectomy also demonstrated low intraoperative and postoperative complication rates, minimal blood loss, and no reoperations or readmissions within 30 days.

Robotic-Assisted Surgery for Endometrial Cancer
Evidence from multiple systematic reviews and meta-analyses consistently indicate that robotic-assisted surgery for endometrial cancer is associated with a favourable safety profile compared to laparotomy and laparoscopy. Robotic-assisted surgery significantly reduces intraoperative and postoperative complications, blood loss, transfusion rates, and conversion to open surgery. In patients with obesity, robotic-assisted surgery maintains low perioperative complication rates and shows reduced conversion rates.

Robotic-Assisted Surgery for Sacrocolpopexy in Pelvic Organ Prolapse
Multiple systematic reviews have demonstrated that robotic-assisted sacrocolpopexy is consistently associated with lower blood loss, fewer conversions to open surgery, and high anatomical success rates. Although overall complication and transfusion rates are similar between robotic and laparoscopic sacrocolpopexy, robotic sacrocolpopexy shows low rates of mesh-related complications and reoperations. Some evidence indicates increased postoperative pain and analgesic use with RSC, but serious adverse events remain uncommon.

Robotic-Assisted Surgery for Stress Urinary Incontinence
Evidence from recent studies suggests that robotic-assisted artificial urinary sphincter implantation in women with stress urinary incontinence offers favourable continence outcomes, with pooled rates ranging from 72% to 83%. However, complication rates remain considerable, with intraoperative complications reported in up to 21% of cases and postoperative complications in approximately 20–27%.

Economic Implications
Multiple studies highlight the substantially higher costs associated with robotic-assisted surgery compared to conventional approaches. Robotic hysterectomy was the most expensive among all hysterectomy types, primarily due to equipment and maintenance costs, while offering clinical benefits in complex cases. In gynaecologic oncology, robotic-assisted surgery demonstrated higher operative and equipment costs, but also yielded lower blood loss, fewer conversions, and shorter hospital stays in some studies. Cost-effectiveness appears limited and may only be achieved in high-volume centres or with cost-saving strategies.

Organisational Issues

Training Despite widespread availability of robotic systems and simulators in training institutions, formalized curricula for robotic-assisted surgery remain limited. Many residents lack faculty-led instruction and hands-on opportunities to serve as primary surgeons. Key barriers include time constraints, limited simulator access, and faculty reluctance. However, most trainees express strong interest in pursuing robotic certification and integrating robotics into future practice, highlighting the need for structured, standardized training programs in residency.

Perception of healthcare experts

Healthcare professionals generally perceive robotic-assisted surgery as a valuable innovation that enhances clinical performance and hospital reputation. However, adoption remains limited due to financial barriers, training gaps, and infrastructural constraints. While some experts support its selective use in complex cases, others advocate broader implementation due to perceived advantages in precision, ergonomics, and recovery time. Despite favourable views, concerns persist around resident readiness and inconsistent training exposure, suggesting a need for standardized curricula and robust credentialing pathways to support future adoption.

Guidelines

Numerous international and regional bodies have issued guidelines to support the safe, effective, and standardized implementation of robotic-assisted surgery in gynaecology. These guidelines consistently emphasize key areas including appropriate patient selection, surgeon training and credentialing, informed consent, and quality assurance mechanisms. In highincome and regional contexts alike, structured curricula, simulation-based training, and certification processes are promoted to ensure surgical proficiency.

Ethical Issues

While robotic-assisted surgery offers technological advancements and potential clinical benefits, it raises several ethical concerns. Key issues include ensuring informed consent amidst patient misconceptions, equitable access given the high cost of robotic-assisted surgery, and variability in training that may impact surgical competency and patient safety. Inconsistent evidence of clinical superiority, coupled with significantly higher costs, also raises questions about justifiable resource allocation in public healthcare. Additionally, potential conflicts of interest such as those driven by industry partnerships highlight the need for transparency and evidence-based decision-making to maintain ethical, patient-centered care.

CONCLUSION

Robotic-assisted surgery for gynaecological disorders demonstrates comparable safety and clinical effectiveness to conventional approaches, with potential advantages in reducing blood loss, shortening hospital stays, and enhancing surgical precision, particularly in complex cases. However, these benefits are accompanied by significantly higher costs, longer operative times, and limited long-term outcome data. Significant organizational challenges were identified, including inconsistent training, limited resident autonomy, and the absence of standardized curricula, all of which may compromise surgical proficiency and patient safety. Although

international and regional guidelines emphasize structured education and credentialing, their implementation across settings remains highly variable.