



The potential of artificial intelligence
as an equalizer of gender disparity
in surgical training



Dr.ssa Valentina Mari





Mari *et al.* *Art Int Surg* 2022;2:122-31
 DOI: 10.20517/ais.2022.12

**Artificial
 Intelligence Surgery**

Review

Open Access

[Check for updates](#)

The potential of artificial intelligence as an equalizer of gender disparity in surgical training and education

Valentina Mari¹, Gaya Spolverato¹, Linda Ferrari²

¹Department of Surgical, Oncological and Gastroenterological Sciences, University of Padova, Padova 35128, Italy.
²Colorectal and Pelvic Floor Department, Guy's and St Thomas NHS foundation Trust, London SE17EH, UK.

Correspondence to: Dr. Valentina Mari, Department of Surgical, Oncological and Gastroenterological Sciences, University of Padova, Via Giustiniani 2, Padova 35128, Italy. E-mail: valentina.mari9@gmail.com

How to cite this article: Mari V, Spolverato G, Ferrari L. The potential of artificial intelligence as an equalizer of gender disparity in surgical training and education. *Art Int Surg* 2022;2:122-31. <https://dx.doi.org/10.20517/ais.2022.12>

Received: 29 May 2022 **First Decision:** 11 Jul 2022 **Revised:** 30 Jul 2022 **Accepted:** 10 Aug 2022 **Published:** 18 Aug 2022

Academic Editors: Isabella Frigerio, belinda de simone. **Copy Editor:** Peng-Juan Wen **Production Editor:** Peng-Juan Wen

- Female enrollment in medical schools has steadily increased, over the last decades.

Not proportional rise in females s

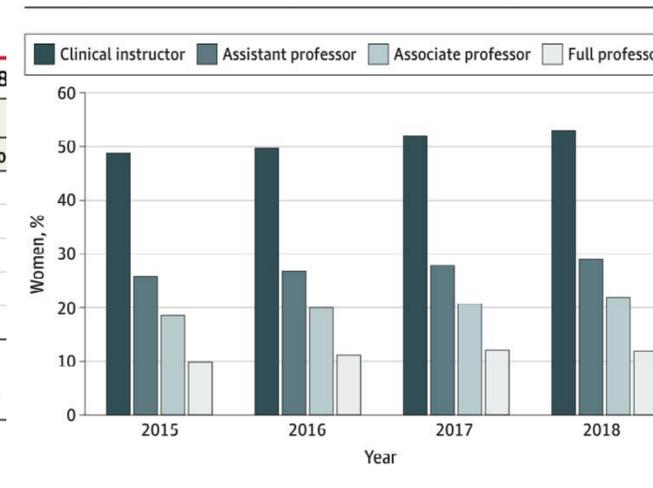
Table 2. Comparison of Academic Rank for Women in Medicine and Surgical Fields in 2018

Rank	Women in each surgical specialty by rank, No. (%)			
	Medicine	Surgery	Ob/Gyn	Ophthalmolo
Instructor	9156 (58)	575 (53)	558 (82)	181 (57)
Assistant professor	38 151 (47)	2036 (29)	2199 (71)	565 (45)
Associate professor	13 642 (38)	727 (21)	675 (57)	234 (37)
Professor	9501 (25)	411 (21)	406 (36)	179 (21)
Department chair	618 (19)	24 (6)	42 (28)	14 (14)

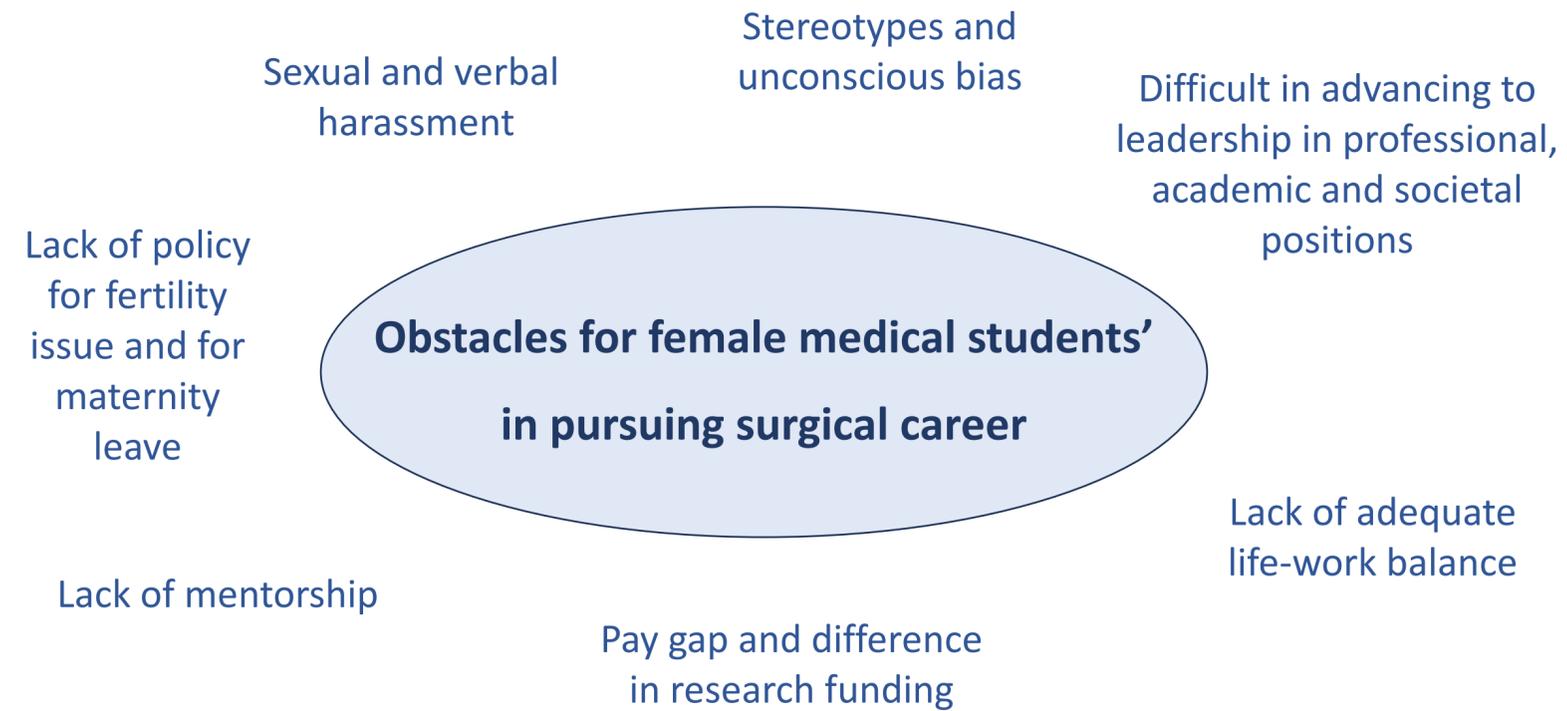
Abbreviation: Ob/Gyn, obstetrics/gynecology.

^a Data from gender-related workforce metric on the AAMC data reports portion of the website.⁷⁰

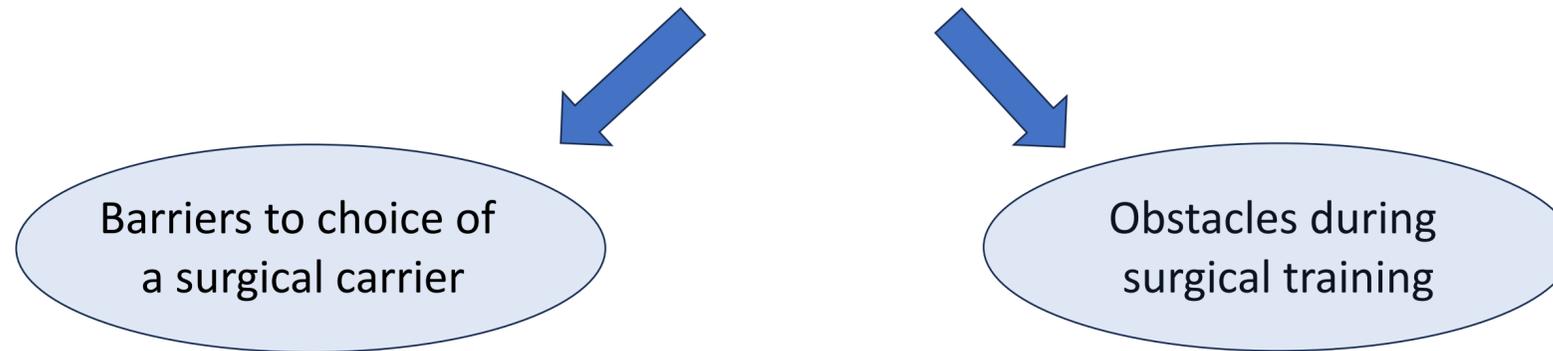
Figure. Percentage of Women Surgeons Among Medical School Faculty Rank From 2015 Through 2018



- Stephens EH, Heisler CA, Temkin SM, Miller P. The Current Status of Women in Surgery: How to Affect the Future. *JAMA Surg.* 2020 Sep 1;155(9):876-885. doi: 10.1001/jamasurg.2020.0312.



Main types of discrimination in surgical education and training program



- Giantini Larsen AM, Pories S, Parangi S, Robertson FC. Barriers to Pursuing a Career in Surgery: An Institutional Survey of Harvard Medical School Students. *Ann Surg.* 2021 Jun 1;273(6):1120-1126.
- Marks, I.H., Diaz, A., Keem, M. *et al.* Barriers to Women Entering Surgical Careers: A Global Study into Medical Student Perceptions. *World J Surg* 2020 44, 37–44.

Barriers to choice of a surgical carrier

- Gender based stereotypes
- Perception of a male dominated field
- Length of training
- Poor work-life balance
- Time to date, marry or taking maternity during residency
- Lack of female surgeons as role model

Obstacles during surgical training

- Gender stereotypes
- Inequity in residency application process
- Sexual and verbal harassment
- Disparities in operative autonomy and evaluation
- Discrimination for family planning and pregnancy
- Residency leave
- Higher rate of burnout, depression, suicidal thoughts

Role of Artificial Intelligence in surgery



Review

Artificial Intelligence Surgery: How Do We Get to Autonomous Actions in Surgery?

Andrew A. Gumbs ^{1,*}, Isabella Frigerio ², Gaya Spolverato ³, Roland Croner ⁴, Alfredo Illanes ⁵,
Elie Chouillard ¹ and Eyad Elyan ⁶



Role of Artificial Intelligence in surgery



Role of Artificial Intelligence in surgery

Review > JAMA Surg. 2018 Aug 1;153(8):770-771. doi: 10.1001/jamasurg.2018.1512.

Automated Performance Metrics and Machine Learning Algorithms to Measure Surgeon Performance and Anticipate Clinical Outcomes in Robotic Surgery

Andrew J Hung¹, Jian Chen¹, Inderbir S Gill¹

> JAMA Netw Open. 2020 Mar 2;3(3):e201664. doi: 10.1001/jamanetworkopen.2020.1664.

Evaluation of Deep Learning Models for Identifying Surgical Actions and Measuring Performance

Shuja Khalid¹, Mitchell Goldenberg¹, Teodor Grantcharov¹, Babak Taati¹, Frank Rudzicz¹

> JAMA Netw Open. 2019 Aug 2;2(8):e198363. doi: 10.1001/jamanetworkopen.2019.8363.

Machine Learning Identification of Surgical and Operative Factors Associated With Surgical Expertise in Virtual Reality Simulation

Alexander Winkler-Schwartz¹, Recai Yilmaz¹, Nykan Mirchi¹, Vincent Bissonnette^{1 2}, Nicole Ledwos¹, Samaneh Siyar^{1 3}, Hamed Azarnoush^{1 3}, Bekir Karlik¹, Rolando Del Maestro¹

Role of Artificial Intelligence in surgery

Review > [Int J Surg.](#) 2016 May;29:85-94. doi: 10.1016/j.ijso.2016.03.034. Epub 2016 Mar 15.

Virtual reality training in laparoscopic surgery: A systematic review & meta-analysis

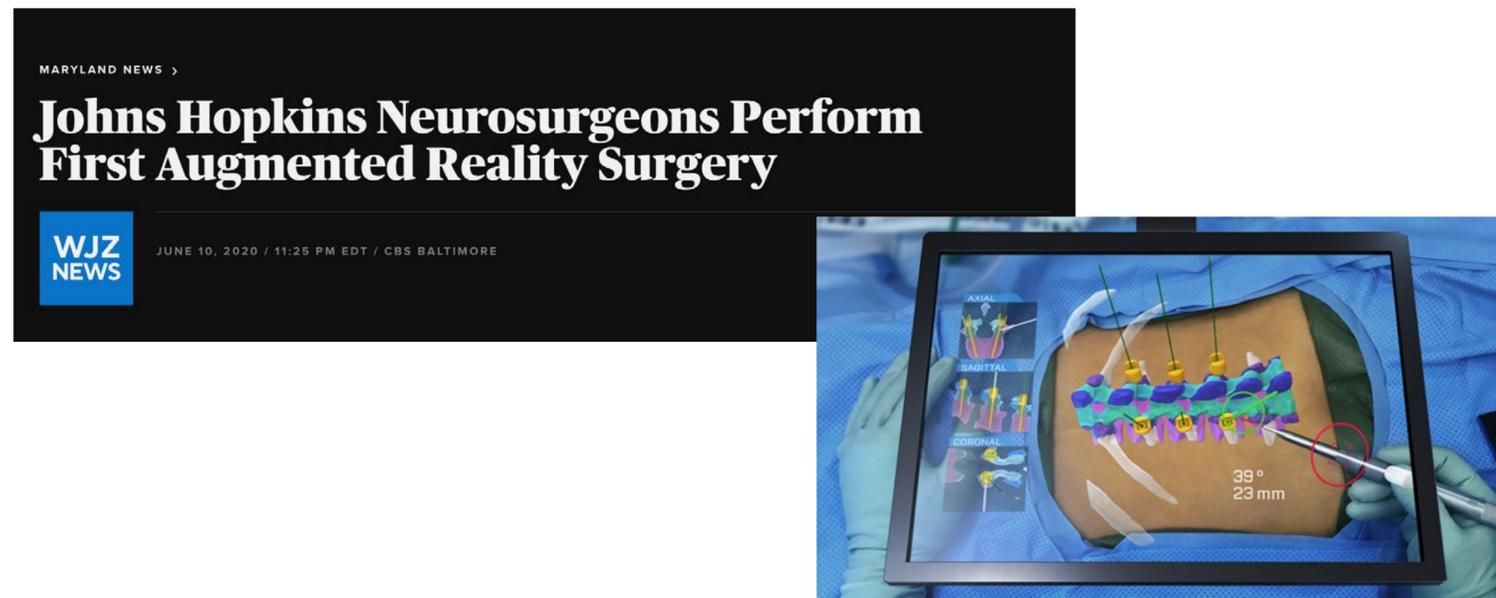
[Medhat Alaker](#)¹, [Greg R Wynn](#)², [Tan Arulampalam](#)²

Review > [Teach Learn Med.](#) 2015;27(1):12-26. doi: 10.1080/10401334.2014.979181.

A review of training research and virtual reality simulators for the da Vinci surgical system

[May Liu](#)¹, [Myriam Curet](#)

Role of Artificial Intelligence in surgery



Role of Artificial Intelligence for women in surgical training

Mari et al. *Art Int Surg* 2022;2:122-31
DOI: 10.20517/ais.2022.12

Artificial
Intelligence Surgery

Review

Open Access

Check for updates

The potential of artificial intelligence as an equalizer of gender disparity in surgical training and education

Valentina Mari¹, Gaya Spolverato¹, Linda Ferrari²

¹Department of Surgical, Oncological and Gastroenterological Sciences, University of Padova, Padova 35128, Italy.
²Colorectal and Pelvic Floor Department, Guy's and St Thomas NHS foundation Trust, London SE17EH, UK.

AIM OF THE STUDY
Investigate if AI could represent an effective way to overcome barriers related to gender disparity and overcome the obstacles women face during surgical education and training

Role of Artificial Intelligence for women in surgical training

AJS The American Journal of Surgery

Articles Publish Multimedia About Contact

FEATURED ARTICLE | VOLUME 222, ISSUE 6, P1051-1059, DECEMBER 2021

Download Full Issue

Use of artificial intelligence for gender bias analysis in letters of recommendation for general surgery residency candidates

Daniel Sarraf • Vlad Vasilii • Ben Imberman • Brenessa Lindeman

Published: October 01, 2021 • DOI: <https://doi.org/10.1016/j.amjsurg.2021.09.034> • Check for updates



Role of Artificial Intelligence for women in surgical training

- Less operative autonomy
- No demonstration of worse performance
- Tendency to underestimate the surgical ability



Artificial Intelligence for an objective evaluation of performance during laparoscopic and robotic training

- Minter RM, Gruppen LD, Napolitano KS, Gauger PG. Gender differences in the self-assessment of surgical residents. *Am J Surg.* 2005 Jun;189(6):647-50.
- Flyckt RL, White EE, Goodman LR, Mohr C, Dutta S, Zanotti KM. The Use of Laparoscopy Simulation to Explore Gender Differences in Resident Surgical Confidence. *Obstet Gynecol Int.* 2017;2017:1945801.

Role of Artificial Intelligence for women in surgical training

Robotic and laparoscopic simulators based on virtual reality

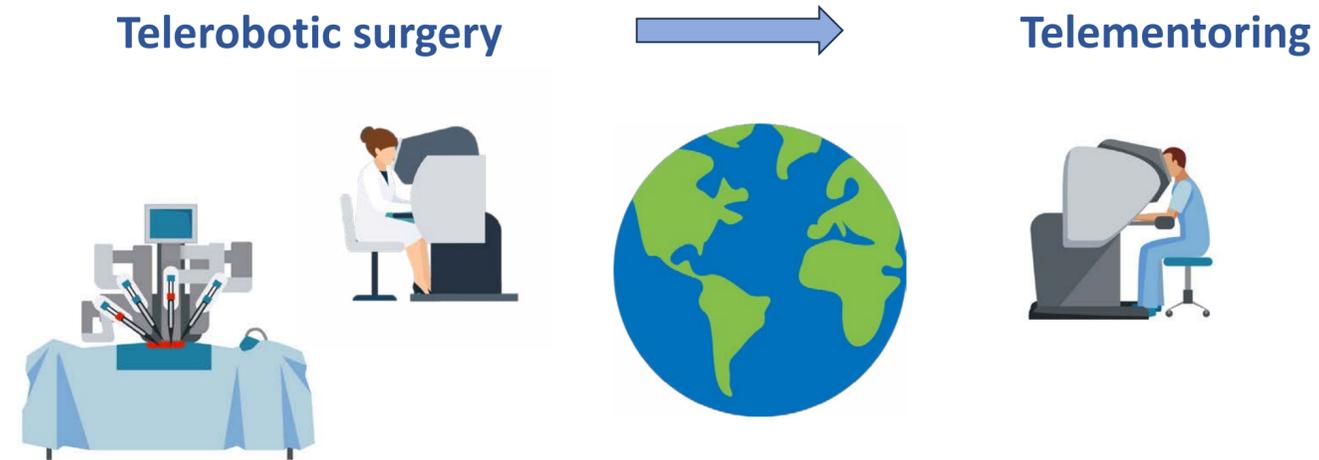


Opportunity to train every time and everywhere



Continuous surgical training also during period of leave (e.g. maternity leave or for obtaining a better life-work balance)

Role of Artificial Intelligence for women in surgical training



- Erridge S, Yeung DKT, Patel HRH, Purkayastha S. Telementoring of Surgeons: A Systematic Review. Surg Innov. 2019 Feb;26(1):95-111.
- Anvari M, Manoharan B, Barlow K. From telementorship to automation. J Surg Oncol. 2021 Aug;124(2):246-249.

Role of Artificial Intelligence for women in surgical training



Journal of Surgical Education
Volume 79, Issue 5, September–October 2022, Pages 1166–1176



ORIGINAL REPORTS

The Impact of Same Gender Speed-Mentoring on Women's Perceptions of a Career in Surgery – A Prospective Cohort Study

Maria Georgi BSc*, Naomi Morka BSc*, Sonam Patel BSc*, Danny Kazzazi BSc*,
Khimi Karavadra BSc*, Arjun Nathan MBBS†, Gillian Hardman FRCSEd, MBBS, MSc, BSc†,
Janice Tsui MB, BChir, MD, FRCS†

CONCLUSION

This study demonstrated that speed-mentoring by same-gender mentors is an effective intervention for addressing negative perceptions of a surgical career for aspiring female surgeons. This can provide an efficient additional approach for surgical organizations in supporting and developing diversity in surgical practice through mentorship.

Telementoring



Open issue of AI in surgical training

- High costs
- Technical requirements
- Enormous dataset is required
- Data security
- Ethical issue

- O'Sullivan S, Nevejans N, Allen C, Blyth A, Leonard S, Pagallo U, Holzinger K, Holzinger A, Sajid MI, Ashrafian H. Legal, regulatory, and ethical frameworks for development of standards in artificial intelligence (AI) and autonomous robotic surgery. *Int J Med Robot.* 2019 Feb;15(1):e1968.
- Park CW, Seo SW, Kang N, Ko B, Choi BW, Park CM, Chang DK, Kim H, Kim H, Lee H, Jang J, Ye JC, Jeon JH, Seo JB, Kim KJ, Jung KH, Kim N, Paek S, Shin SY, Yoo S, Choi YS, Kim Y, Yoon HJ. Artificial Intelligence in Health Care: Current Applications and Issues. *J Korean Med Sci.* 2020 Nov 2;35(42):e379.

Conclusions

AIS permits remote training and telementoring and could improve female surgeons' education worldwide.

AI could contribute to breaking down gender disparity in surgical training, and, consequently, it could encourage women to choose a surgical career.

The development of systematic AI-based training and education programs could encourage women to choose a surgical career and help break down gender disparity during surgical training.



Conclusions



AI does not represent THE solution, but part of it

Some issues that should be faced were observed

Grazie per l'attenzione



Delitti in materia di violazione del diritto d'autore (Art. 25-novies, D.Lgs. n. 231/2001) [articolo aggiunto dalla L. n. 99/2009]

- Messa a disposizione del pubblico, in un sistema di reti telematiche, mediante connessioni di qualsiasi genere, di un'opera dell'ingegno protetta, o di parte di essa (art. 171, legge n.633/1941 comma 1 lett. a) bis)
- Reati di cui al punto precedente commessi su opere altrui non destinate alla pubblicazione qualora ne risulti offeso l'onore o la reputazione (art. 171, legge n.633/1941 comma 3)
- Abusiva duplicazione, per trarne profitto, di programmi per elaboratore; importazione, distribuzione, vendita o detenzione a scopo commerciale o imprenditoriale o concessione in locazione di programmi contenuti in supporti non contrassegnati dalla SIAE; predisposizione di mezzi per rimuovere o eludere i dispositivi di protezione di programmi per elaboratori (art. 171-bis legge n.633/1941 comma 1)
- Riproduzione, trasferimento su altro supporto, distribuzione, comunicazione, presentazione o dimostrazione in pubblico, del contenuto di una banca dati; estrazione o reimpiego della banca dati; distribuzione, vendita o concessione in locazione di banche di dati (art. 171-bis legge n.633/1941 comma 2)
- Abusiva duplicazione, riproduzione, trasmissione o diffusione in pubblico con qualsiasi procedimento, in tutto o in parte, di opere dell'ingegno destinate al circuito televisivo, cinematografico, della vendita o del noleggio di dischi, nastri o supporti analoghi o ogni altro supporto contenente fonogrammi o videogrammi di opere musicali, cinematografiche o audiovisive assimilate o sequenze di immagini in movimento; opere letterarie, drammatiche, scientifiche o didattiche, musicali o drammatico musicali, multimediali, anche se inserite in opere collettive o composite o banche dati; riproduzione, duplicazione, trasmissione o diffusione abusiva, vendita o commercio, cessione a qualsiasi titolo o importazione abusiva di oltre cinquanta copie o esemplari di opere tutelate dal diritto d'autore e da diritti connessi; immissione in un sistema di reti telematiche, mediante connessioni di qualsiasi genere, di un'opera dell'ingegno protetta dal diritto d'autore, o parte di essa (art. 171-ter legge n.633/1941)
- Mancata comunicazione alla SIAE dei dati di identificazione dei supporti non soggetti al contrassegno o falsa dichiarazione (art. 171-septies legge n.633/1941)
- Fraudolenta produzione, vendita, importazione, promozione, installazione, modifica, utilizzo per uso pubblico e privato di apparati o parti di apparati atti alla decodificazione di trasmissioni audiovisive ad accesso condizionato effettuate via etere, via satellite, via cavo, in forma sia analogica sia digitale (art. 171-octies legge n.633/1941).

[Torna all'inizio](#)