Overcoming the Impact of COVID-19 on Surgical Mentorship: A Scoping Review of Long-distance Mentorship in Surgery

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BACKGROUND: Mentorship in the surgical field has been increasingly recognized as a crucial component of career success. Distance mentorship models may be utilized to overcome geographic limitations, increase mentorship access, and strengthen mentoring relationships in surgery.

OBJECTIVE: This review aimed to identify the scope of literature on distance mentoring in surgery, the range of its application, its effectiveness, and any gaps in the literature that should be addressed in order to enhance mentorship in the surgical field.

DESIGN: A comprehensive PubMed review was performed in January 2021 on distance mentorship of students, trainees, and surgeons in the surgical field. Reviews, replies, and non-English articles were excluded. Data was extracted regarding publication year, author's country, specialty, subjects, aim of mentorship model, and efficacy.

RESULTS: 134 total studies met inclusion and exclusion criteria. Most studies were published in 2020, written by authors in the United States, from general surgery, and featured an expert surgeon paired with a more junior fully trained surgeon. In all, 93.3% of studies utilized distance mentorship to enhance surgical skill through telementoring and only 4.5% were focused on mentorship to enhance careers through professional development. The remaining studies utilized distance mentorship models to increase surgical research (0.7%) and clinical knowledge (1.5%).

CONCLUSION: The results of this review suggest successful implementation of distance mentoring in surgery through telementoring, but a lack of professionally aimed distance mentorship programs. Amidst COVID-19, distance mentorship is particularly important because of decreased face-to-face opportunity. Future studies in the surgical field should investigate distance mentoring as a means of increasing mentorship for professional development. (J Surg Ed 78:1948–1964. © 2021 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: e-mentor, telementor, training, remote, virtual, education

COMPETENCIES: Medical Knowledge, Professionalism, Interpersonal and Communication Skills

INTRODUCTION

Mentorship in surgery has significant benefits to both the mentor and mentee. The mentor-mentee relationship has been defined as "a dynamic reciprocal relationship in a work environment between a career incumbent (mentor) and a beginner protégé (mentee), aimed at promoting development of both."[1] Mentorship in surgery has been shown to increase academic productivity, funding, leadership roles, job retention, and advance mentees' careers, while reducing burnout.[1-12] Mentors benefit by learning from the mentee, validating their knowledge and accomplishments, and through increased job satisfaction.[7,13] Mentorship in surgery should be optimized to increase the overall professional and personal well-being of students and surgeons at all career stages.

Distance mentorship, meaning the mentor and mentee are located in different geographic areas, utilizes technology to create a boundaryless, egalitarian, and qualitatively different mentoring relationship.[14] Distance mentorship models have been successfully implemented in the fields of academic medicine,[15-19] nursing,[20-22] medical research,[23-25] and business.[26,27] These models can increase mentorship of individuals with few local mentors and diversify mentorship networks.[14,28-30] Distance

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mentorship in medicine can take many forms, focusing on education, skill achievement, research productivity, or professional and personal development.[24,31,32] The focus of this review included students, trainees, and surgeons within the surgical field, the implementation of distance mentorship in their training and careers, and its impact on skill acquisition, research, and professional development compared to in-person and no mentorship.

METHODS

A scoping review of the literature was performed in January 2021. Peer-reviewed articles were identified by a single author (L.N.R) using PubMed. Search terms that related to distance mentorship were used with Boolean operators, listed in Table 1. The authors' personal saved files were also searched for relevant publications.

TABLE 1. Search Terms Used in PubMed to Identify Articles Relevant to Distance Mentorship in Surgery and Number of Results

Term	Search Phrase	Number of Publications
Distance mentor in surgery	("distance"[All Fields] OR "distances"[All Fields]) AND ("mentor s"[All Fields] OR "mentored"[All Fields] OR "mentoring"[MeSH Terms] OR "mentoring"[All Fields] OR "mentors"[MeSH Terms] OR "mentors"[All Fields] OR "mentor"[All Fields]) AND ("surgery"[MeSH Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields] OR "surgery s"[All Fields] OR "surgerys"[All Fields] OR "surgeries"[All Fields])	59
Telementor in surgery	("telementor"[All Fields] OR "telementored"[All Fields] OR "telementoring"[All Fields]) AND ("surgery"[MeSH Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields] OR "surgery s"[All Fields] OR "surgerys"[All Fields] OR "surgeries"[All Fields])	238
E-mentor in surgery	("e-mentoring"[All Fields] AND ("surgery"[MeSH Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields] OR "surgery s"[All Fields] OR "surgerys"[All Fields] OR "surgeries"[All Fields])) OR ("e-mentor"[All Fields] AND ("surgery"[MeSH Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields] OR "surgery s"[All Fields] OR "surgerys"[All Fields] OR "surgeries"[All Fields]))	2
Virtual mentor in surgery	("virtual"[All Fields] OR "virtuality"[All Fields] OR "virtualization"[All Fields] OR "virtualized"[All Fields] OR "virtualizing"[All Fields] OR "virtuals"[All Fields]) AND ("mentor s"[All Fields] OR "mentored"[All Fields] OR "mentoring"[MeSH Terms] OR "mentoring"[All Fields] OR "mentors"[MeSH Terms] OR "mentors"[All Fields] OR "mentor"[All Fields]) AND ("surgery"[MeSH Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields] OR "surgery s"[All Fields] OR "surgerys"[All Fields] OR "surgeries"[All Fields])	257

TABLE 2. Inclusion and Exclusion Criteria for Articles Selected to Examine Distance Mentorship in Surgery

Inclusion Criteria
Addresses, proposes, discusses, or exemplifies geographically distant mentor-mentee relationship
Geographically distant mentorship model utilized in a surgical field
Exclusion Criteria
Duplicate
Does not meet inclusion criteria
Non-English
Published Abstract
Mentor and/or mentee is not a medical student, surgical trainee, or surgeon
Review article
Reply article

Articles were screened by title and abstract, using inclusion and exclusion criteria listed in Table 2. Full-text review was performed on remaining articles. Inclusion criteria included reports of geographically distant mentorship within surgery. No limitation was placed on year or publication status. Articles that were duplicates, non-English, reviews, or replies were excluded due to the native language of the authors and so that duplicates would not be reported. Also, articles in which the mentor and/or mentee was not a premedical or medical student, surgical trainee (resident or fellow), or fully trained surgeon were excluded. Published abstracts were excluded. Data was manually extracted, as available, and stored using a standardized spreadsheet. A full-text review was conducted for all but 2 included articles, for which full-text access was unavailable, so data was extracted from the abstract. The categories of data extracted from each study are listed in Table 3.

Several presumptions were made during data collection. Country of authors was assumed to be the same, if only the first author's country was published. Surgical specialty was determined by the text or journal and categorized as general surgery, if not specified. In telementored cases, the operation, if specified, was used to confirm that categorization into general surgery was acceptable. When sorting articles into types of mentorship, including educational, professional, telementoring, or research, the prevailing theme was selected, although some articles had mixed aspects. The career stage of the mentees was determined by the text, but if not explicitly stated, the context of the publication was used. If this was still unclear, the mentee was categorized as "unspecified" training level.

TABLE 3. Data Extracted from Included Publications

Year
Title
Journal
Author
Country
Publication Type
Model proposed or enacted
Mentor and mentee characteristics
Number of participants
Type of mentorship (Telesurgery, Educational, Professional)
Theme (COVID-19, Rural, International, Military)
Efficacy (Mentee skill and professional development, patient outcomes)
Unique technology, mode of communication
Quantitative or Qualitative outcomes
Results and conclusions
Study limitations

RESULTS

Selection of Studies

PubMed search yielded 556 publications. Of these, 464 were screened by the title and abstract and 194 were reviewed via the full text (Fig. 1). Additionally, the lead author (L.N.R.) found 4 articles relevant to the study in her files. Following screening, 134 articles met inclusion and exclusion criteria. 426 articles were excluded because they were duplicates (N = 53), did not meet inclusion criteria (N = 241), were not in the English language (N = 39), were published abstracts (N = 4), review articles (N = 62), or replies (N = 2), and because the mentor and/or mentee was not a student, surgical trainee, or surgeon (N = 25).

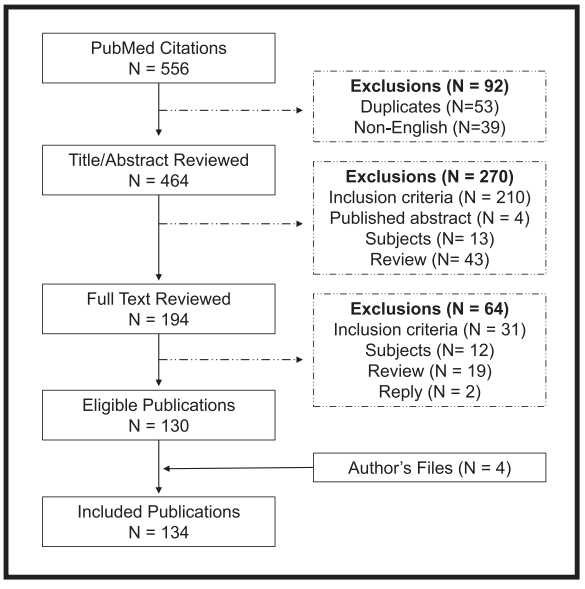

FIGURE 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart.

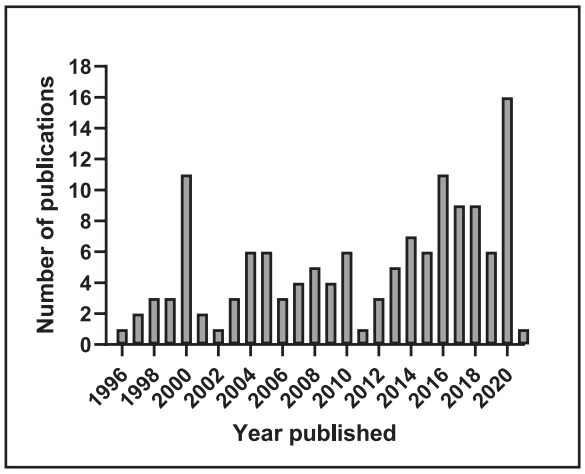

FIGURE 2. A graphical history of the published studies addressing distance mentorship in surgery.

Study Characteristics

The distribution of publications spanned from 1996 to 2021, peaking in 2020 (N = 16, 11.9%) (Fig. 2). Publications were primarily written by United States (N = 64, 47.8%),[25,33-95] internationally collaborating (N = 31, 23.1%),[96-126] and Canadian authors (N = 13, 9.7%)[127-139] (Fig. 3). The United Kingdom[140-143] and Japan[144-147] each had 4 publications (3.0% each). France,[148-150] India,[151-153] and Norway[154-156] had 3 publications (2.2% each). Italy[157,158] and Switzerland[159,160] had 2 publications (1.5% each). Africa,[161] Austria,[162] the Caribbean,[163] Iran,[164] and Spain[165] each had 1 publication (0.8% each). Publications in General Surgery (N = 75, 56.0%)[25,34-40,42,43,46,47,51-53,55-58,60-64,68,69,71,74,76,80,81,84,86,89-91,93-96,98,102,105,109,116-119,121-123,125-132,134,137-139,141,142,145,147-151,153-156] and Urology (N = 13, 9.7%)[50,59,67,77,88,97,99,107,108,112,120,144,164] were most prevalent (Fig. 4). Cardiovascular had 5 publications.[70,72,110,111,160] Endocrine,[79,113,152,157] Neurosurgery,[45,54,92,133] Ophthalmology,[48,66,83,143] and Pediatric Surgery[49,65,87,100] had 4 publications. Obstetrics and Gynecology had 3 publications,[73,104,114] along with Orthopedics,[82,136,161] and Trauma.[85,106,135] Colorectal,[103,115] Otolaryngology,[33,44] Oral and Maxillofacial Surgery,[158,162] and Plastic and Reconstructive Surgery[41,146] each had 2 publications. Bariatric,[165] Endovascular,[140] Hepatobiliary,[163] Transplant,[101] and Vascular[159] each had 1 publication. In combined specialty publications, there were 2 that were Otolaryngology and Neurosurgery,[75,124] and 1 publication that was Trauma, Vascular, and Orthopedics.[78]

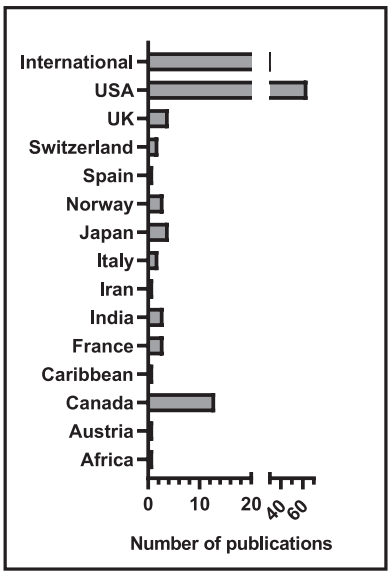

FIGURE 3. The number of publications on distance mentorship in surgery by author's country.

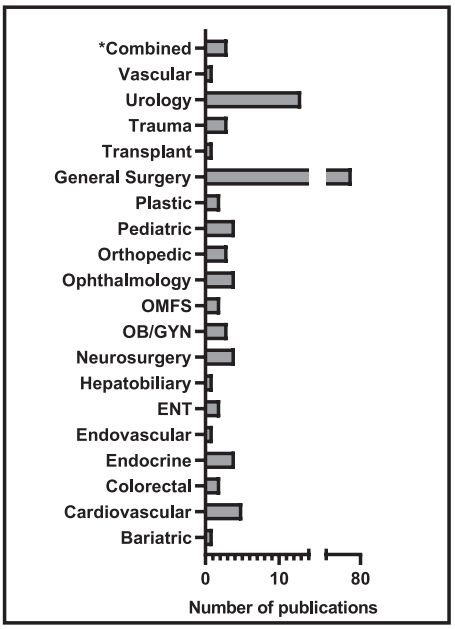

FIGURE 4. The number of publications by surgical specialty. (*) Combined includes: Otolaryngology and Neurosurgery (N = 2), Trauma, Vascular, and Orthopedic Surgery (N = 1). OMFS, oral and maxillofacial surgery; OB/GYN, Obstetrics and Gynecology.

Distance Mentorship Models

Distance mentorship models mentioned in the literature aimed to increase the mentee's knowledge, skill, research productivity, and professional development (Fig. 5). Models of distance mentoring most frequently utilized or proposed telementoring (N = 125, 93.3%). Telementoring is a technique through which an experienced physician guides a lesser experienced physician or healthcare professional in a remote location.[166] If this occurs intra-operatively, it is termed *telesurgical telementoring*.[166] Telesurgical telementoring was discussed

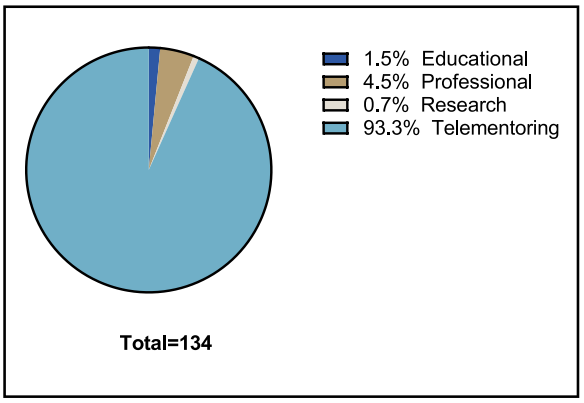

FIGURE 5. Proportions of publications with an educational (N = 2, 1.5%), professional (N = 6, 4.5%), research (N = 1, 0.7%), and telementoring (N = 125, 93.3%) focus.

in 123 publications.[34-40,42-53,55,57-104,106-109,111-113,115-140,142-150,152-160,162-165] Telesurgical telementoring has been primarily used to increase a mentee's surgical skill. Amparore et al., however, suggested that telesurgery could be utilized to increase urology residents' operative exposure during COVID-19 after identifying a decrease in their surgical and clinical training activities.[97] Similarly, Redleaf et al. suggested that telesurgery could be used to increase medical students' surgical experience during COVID-19 despite sub-internships and in-person surgical participation limitations.[44] Telementoring can also be used to provide physicians with clinical advice. This was used in the literature to guide community physicians through orthopedic fracture treatment[105] and perimuscular hematoma mangement.[161] Overall, most distance mentorship models centered around telesurgical telementoring.

Models seeking to improve clinical knowledge, but not centered around a specific patient were categorized as educational (N = 2, 1.5%).[114,151] Project Extension for Community Healthcare Outcomes (ECHO), a didactic and discussion-based platform, was used to improve gynecologic oncology outcomes in Mozambique.[114] A mentorship model that emphasized self-assessment and discussion was proposed by Agrawal, et al., aiming to enhance resident surgical education despite decreased surgical participation opportunities during COVID-19.[151]

Only 1 publication (0.7%) utilized a research driven distance mentorship model.[25] Through the Surgical Education Research Fellowship, trainees were paired with mentors in various locations based on common interest.[25] Mentees optimized academic productivity without distance limitations.[25]

Six publications (4.5%) implemented distance mentorship models for professional development.[33,41,54,56,110,141] Guadix et al. surveyed medical students interested in neurosurgery and identified several concerns related to COVID-19, including a perceived loss of networking opportunities, clinical experiences, and decreased board scores. Several solutions were proposed with the highest rated among medical students being virtual mentorships and skills workshops.[54] Farlow et al. discussed an experiential void that could dimmish otolaryngology interested senior medical students' chances of matching due to COVID-19 restrictions. They suggested that a 1-day virtual event with educational sessions, residency application advice, and opportunities to meet and form mentorship relationships with faculty and residents could be utilized to overcome this challenge.[33] Moreno et al. cautioned against the potential for COVID-19 to diminish mentorship opportunities for underrepresented minority medical students and proposed a surgery department sponsored distance mentorship model through which minority medical students could seek career advice, increase their network, and research opportunity.[56] Luc et al. demonstrated the utility of social media to broaden the female surgical mentorship network and the effectivity of its use.[110] Weber and Khosravani, medical students interested in plastic surgery, used social media to gain a global network of plastic surgery mentors.[41] Jaffer et al. presented surgical trainees with a virtual mentorship world centered, called MentorSL, which was well received.[141] The scope of literature surrounding the professional distance mentorship model in surgery was limited, but its utility in compensating for COVID-19 related changes was recognized.

Distance Mentorship Participants: Students, Surgical Trainees, and Surgeons

The subjects of these distance mentorship models included all levels from students to fully trained surgeons. Mentors, being more experienced, were typically fully trained physicians, but surgical trainees, meaning residents and fellows, were used in 2 publications.[59,74] Mentees were frequently fully trained but less experienced physicians (N = 59, 44%) (Fig. 6).[46,48-50,53,66,67,69,70,72,75,79,83,87,93,94,99-103,105-108,112-115,120-122,124-126,129-131,133,134,136,137,139,144,147-150,152,153,155-157,159-163,165] Publications also featured mentees that were surgical trainees, including surgical residents and/or fellows, (N = 23, 17%).[25,34,39,47,52,59,62,74,78,81,82,88,96,97,104,109,132,141,142,145,146,151,164] In other distance mentorship models, the mentees were students (N = 14, 10%)[33,35-38,41,54-56,84,85,117,154,158] who either completed a telesurgical task[55,84,167-174] or were interested in pursuing a surgical career.[33,41,54,56] In remaining articles, mentees were of more than one of these forementioned categories, (N = 15, 11%),[43-45,60,64,71,76,77,95,110,116,118,119,135,138] while some articles did not specify the training

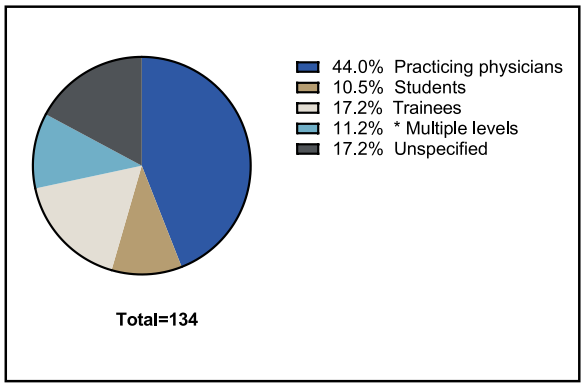

FIGURE 6. Proportions of publications with mentees who were practicing physicians and had completed training (N = 5944.0%), students (N = 14, 10.5%), trainees (N = 23, 17.2%), multiple levels (N = 15, 11.2%), and unspecified (N = 2317.2%). (*) Multiple levels includes practicing physicians and trainees (N = 6), students and trainees (N = 7), students and practicing physicians (N = 1), and students, trainees, and practicing physicians (N = 1).

or career level of the mentee (N = 23, 17%).[40,42,51,57,58,61,63,65,68,73,80,86,89-92,98,111,123,127,128,140,143]

Subgroup populations included mentees internationally based, rural or community based, military affiliated, females, or affected by COVID-19, each of which needed to increase their mentorship network beyond their local community. International distance mentorship was a theme in 25 publications, utilized frequently in telementoring to decreasing cost and time required by mentee to gain a new skill and improve patient care in an underserved country.[50,66,73,75,93,99-103,105,107,108,112-114,119-121,124,138,147-150] Similarly, rural and community based physicians relied on distance mentorship to improve access to surgical specialist guidance.[53,69,83,89,91,106,131,133-137,139,140,152,153,159,161,163] Military physicians utilized distance mentorship to rapidly provide trauma care in austere environments.[35,37,53,55,89,106,135] Two distance mentorship models aimed to increase female-female and minority mentorship.[56,110] Several publications sought to increase educational and professional opportunity for students and trainees amidst COVID-19 via telementoring, virtual courses, and networking opportunities.[33,44,56,97,151] Each subgroup focused on the lack of local available mentors and articulated the need to increase the quality of surgical care, knowledge, and professional guidance.

Technology for Mentorship

Technology utilized in distance mentorship models varied based on the type of distance mentorship model discussed. Surgical telementoring models incorporated two-way audio and real-time video images, as well as telestration which the mentor could use to guide the mentee visually through the surgery.[77] Other technology that could be controlled remotely by the mentor includes and electrocautery,[50,107,112] laser pointers,[52] ghost controls,[64] and robotics like the Karl Storz Endoscopy-America, Inc. VisitOR1 (Karl Storz; Tuttlingen, Germany)[87,100] or the RemotePresence-7 robot (Intouch Health; Santa Barbara, Calif.).[49,67] New virtual reality technology like the System for Telementoring with Augmented Reality (STAR), has been used to provide instruction within the mentee's visual field,[35,37,38,55,71,76] while even newer technology, called the coaxial projective imaging system can be used to project 3D images.[126] iPhones, tablets and small displays have also been incorporated into telementoring to increase convenience.[39,45,47,62,85,94,95,103,105,116,118,125,135,143,156,158,161-163] Along these lines, apps have been used and developed to give on demand mentoring.[118,161] Popular videoconferencing software includes Skype,[87,105,113,128,132,138,146] NetMeeting,[104,119,121,157,164] Google Hangout,[39,112,145] and FaceTime.[39,85,163] Social media has been utilized in professional distance mentorship models.[41,110,141] The importance of this technology is that it can enhance the virtual presence and communication methods of the mentor in the remote environment.

Outcomes, Benefits, and Support

The efficacy and safety of distance mentorship was discussed in literature by comparing distance-mentored groups to those with in-person mentoring and those with no mentoring. These studies primarily centered around telementoring. Telementored surgeons preformed significantly higher on skill assessments than non-mentored groups and performed better on their own after telementored training.[45,52,138] Ereso et al compared the performance of surgical residents using an Operative Performance Scale, with and without telementoring for 3 procedures. Residents scored significantly higher on overall performance with telementoring (4.30 +/- 0.25 versus 2.43 +/- 0.20; $p < 0.001$) and on individual metrics, including tissue and instrument handling, procedure speed, and anatomy knowledge were also superior ($p < 0.001$). Ladd et al. showed that with telementored guidance medical students could improve their identification of anatomic structures from a baseline of 50% ± 10% to 100%, could conduct a craniotomy with no prior procedural knowledge, and that a resident could successfully expose the anterior circulation for the first time.[45] Okrainec et al. showed that telementored surgeons learning laparoscopic skills scored significantly higher on skill assessments (440 +/- 56 versus 272 +/- 95, $p = 0.001$) and were more likely to achieve a certification passing score on the laparoscopic simulator ($p = 0.03$) that those utilizing an instructional DVD.[138] Telementored surgeons in the literature had increased

confidence, incorporated the new skill into practice, and had fewer complications post-mentoring.[46,131,159] Studies which compared distance mentorship with in-person mentorship also yielded favorable results. Telementored groups generally preformed comparably or significantly higher on skills assessments.[36,59,96,117] Vera et al. showed that telementored medical students using a virtual environment demonstrated faster laparoscopic suturing and knot-tying skill acquisition, faster procedure times (mean 167.4 versus 242.4 s, $p = 0.014$), and fewer failures than in-person mentored medical students.[36] Robotic surgery trainees yielded similar skill assessment scores when telementored trainees were compared to in-person mentored trainees by Shin et al.[59] Altieri et al. compared performance of in-person versus videoconference mentored electrosurgery course participants, finding no significant difference in exam scores immediately following the course or after 6 months.[96] Panait et al. assessed laparoscopic skill acquisition of telementored and in-person mentored medical students, finding both improved on right- and left-hand path length and time for grasping, cutting, and suturing with no significant difference between groups.[117] Only in 1 study did the telementored group have a lower performance. Students learning the FAST trauma assessment had lower scores in the Debriefing Assessment for Simulation in Healthcare Student Version Assessment if telementored, but showed a greater improvement from baseline than the in-person mentored group.[85]

There was generally no increase risk to the patient or documented complications because of telementoring. Di Valentino et al. compared endovascular procedures performed by an experienced interventionalist (group A) to procedures performed by a telementored team with a mentor in the same hospital (group B) and with a mentor at a tertiary center (group C). There was no significant difference in duration, time in ICU, or mortality, but the hospital stay was longer for group A than group C.[160] Fuertes-Guiró et al. showed that in laparoscopic bariatric surgery procedures, hospital stay and procedure time was shorter for telementored cases and the only complications (bleeding of surgical wounds, urological infection, and conversions) occurred in non-mentored cases.[165] No significant difference in operative time and blood loss was found for robotic telementored versus in-person mentored procedures by Shin et al.[59] Sawyer et al. demonstrated no significant difference for telementored versus in-person mentored operative time for laparoscopic cholecystectomy and no complications.[74] Hinata et al. identified no significant differences in operative times, complication rates, early continence status, and positive margin rate for telementored versus in-person mentored radical prostatectomy procedures.[144] Mean operative times, blood loss, and postoperative morbidity for telementored laparoscopic adrenalectomies were comparable to standard outcomes for Bruschi et al.[157] Several instances of open conversions and minor complications (intraoperative dysrhythmia, postoperative hemoperitoneum and small-bowel obstruction) were documented in telesurgical procedures, although there was no statistical comparison made to non-telementored cases.[99,137] If a complication does arise, the mentee must be capable enough to handle it on their own due to the mentor's geographically remote location.[87]

Publications that examined mentor and mentee outlook on distance mentorship showed overall positive support for this method, while those that investigated mentee perspective showed a perceived effectiveness.[49,51,69,71,116,124,133,137,149,158] Interestingly, in a study that taught surgeons through both on-site and telementoring methods, on-site mentoring was evaluated as statistically superior to robotic telementoring with significantly more interaction of the mentee with the expert and perceived higher quality of teaching, but only if on-site mentoring was conducted *prior to* telementoring and not if on-site mentoring was conducted *after* telementoring.[149] Generally, the use of distance mentorship was well received.

In the limited number of reports that discussed the effectiveness of distance mentorship outside of telementoring, there also seemed to be success. Distance mentorship of surgical researchers demonstrated successful mentor pairs with no significant difference found in program completion rate based on time zone differences, and found that mean distance between pairs who completed the program was greater than for pairs who did not complete the program, though not statistically significant.[25] Social media was supported by female surgeons as a means of increasing access to female mentors and by medical students as a means of increasing their network in surgery.[41,110]

Disadvantages

Confidentiality is an important consideration for all forms of distance mentorship because electronics leave a digital footprint. In telementoring, the patient may be at risk of health information breach if proper measures are not taken to secure their information.[63,91,128,161] Software that is free and easy to access, such as Skype, may also be the least confidential.[128] Steps should be taken to securely share patient information if telementoring is utilized. This can be done with de-identification, phone calls, and password protection of devices.[161] Even when mentorship is aimed towards professional development, mentees have rated the acknowledgement of confidentiality in exchanges as important.[110]

Additional disadvantages to distance mentorship that are specific to telementoring include technologic glitches, legal issues, and patient support. This includes robotic arm failure,[77,112,134] blurred or poor video signal due to bandwidth or latency,[121,125] loss of transmission,[79] and poor audio quality.[100] Liability issues were also a subject of debate due to various laws and restrictions across the world.[58,75,87,91,100] The necessity of acquiring hospital licensing and credentialing may be an barrier due to inconvenene.[58] Additionally, patients may not support this method. One study revealed that of the general adult population, patients supported the use of telementoring for themselves 58% of the time and for their children 49% of the time, citing concern about the physician's competence as a reason against surgical telementoring 35% of the time.[65]

DISCUSSION

134 studies were identified on the topic of distance mentorship in surgery, written most commonly by authors in the United States. The peak year of publication was 2020. Over 93.3% focused on the use of telementoring and 56.0% were categorized as general surgery related. Mentorship pairs typically featured an expert surgeon matched with a fully trained, but less experienced surgeon. Overall, distance mentorship enhanced learning opportunities for mentees and did not seem to negatively impact performance. Disadvantages of distance mentorship include a higher likelihood of technologic glitches and breached confidentiality when compared to in-person mentorship, however the overall support for distance mentorship models in the surgical field suggests these barriers can be overcome.

Although distance mentorship models may focus on professional, educational, or skill development, the current literature in surgery particularly focused on skill development through telementoring. Advancements in technology and decreased cost have led to a steady rise in publications since the mid-1990s.[175,176] Since its development, novel techniques have been distributed globally through increased access to expert mentors.[58,80,140] Despite this strong-suit, the surgical field lacks literature on the use of distance mentorship for professional development.

The suggested utility of distance mentorship models with a professional aim is that they can be used to increase mentorship of those with decreased local mentor options that fit their needs, including females and minorities.[14,28,31] The issue of suboptimal access to mentorship targeting personal and professional growth has recently gained attention in the surgical field. Particular groups affected by this include trainees, females, and minorities in surgery.[2,110,177-187] Several studies showed high rates of stress and burnout in surgical trainees, correlating with suboptimal mentorship.[10-12,185-187] Female surgeons in training and early career often lack female mentorship, possibly due to a limited number of females in senior positions.[110,177-183] Surgeons of racial and ethnic minorities have faced a similar challenge.[2,184] We included 1 study which showed that that social media could increase access to female mentors in surgery, however future studies in surgery implementing this type of mentorship are needed.[110] Without optimization of professional mentorship for these groups, their interest in the surgical field and academic careers may decline along with retention, productivity, and career trajectory.[177,188-191]

The impact of the COVID-19 pandemic has heightened the risk of suboptimal mentorship in surgery amongst the previously discussed groups and additionally impacted medical students who have fewer opportunities to establish mentorship relationships in-person.[33,54,192-197] New personal and professional challenges prompted by COVID-19 have made mentorship of trainees more important than ever to reduce fatigue and burnout.[10,193,198,199] Additionally, medical students now have decreased face-to-face opportunities to develop mentorship relationships.[33,54,192-194] We demonstrated that in surgery, the largest peak of distance mentorship publications occurred in 2020, the year of COVID-19. Several publications in our findings proposed the utility of virtual mentorship models to compensate for COVID-19 related changes in training.[33,44,56,97,151] Structured mentorship programs sponsored by the surgical department and opportunities to increase networking opportunities were commonly proposed, some of which included virtual conferences, skills workshops, webinars, research pairings, and social medial connectivity. It is plausible that COVID-19 has increased people's comfort with virtual relationships, making distanced mentorship more convenient than ever. Refining distance mentorship models in light of COVID-19 and optimizing their effectiveness may be an effective way to improve mentorship in these groups.

Our review has a number of limitations. The studies selected typically were observational or had low numbers of subjects, thus may feature selection bias. The quality of research on this topic as a whole was lacking, with very few randomized control trials. We made the inclusion criteria broad, however, to incorporate recently published articles set during COVID-19 and to develop a comprehensive review. Several presumptions made during data collection had the potential to skew our findings. Our assumption that authors were from the same country if only 1 country was specified may have diminished the amount categorized into international

studies. Our choice to categorize unspecified surgical specialty publications into general surgery may have inflated this number; however, its high prevalence is consistent with other reviews on telementoring.[200,201] Lastly, the level in training/career was not specified for some mentor-mentee pairs, having the potential to skew our distribution assessment; however, these were largely publications that spoke about telementoring broadly and not comparative studies.

CONCLUSION

Distance mentorship in the surgical field primarily takes the form of telementoring, which increases the mentee's opportunities to enhance surgical skill. COVID-19 has increased personal and professional mentorship needs for students, trainees, recent graduates, females, and minorities. Future studies should propose distance mentorship models with this aim and test their efficacy so that mentorship in the surgical field can be optimized.

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AUTHOR CONTRIBUTIONS

Conceptualization LR, JJ; Data curation LR; Formal analysis LR, JJ; Methodology LR, JJ; Project administration JJ; Resources JJ; Supervision JJ; Writing original draft LR; Writing review & editing JJ.

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