



Vascular E-Learning in Mainland China: Results of the e-Learning During the COVID-19 Pandemic (EL-COVID) Study

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Abstract

Purpose: With the onset of the COVID 19 pandemic, education and continuous professional development took place predominantly online. We investigate the relevance of e-Learning in the vascular surgery community in mainland People's Republic of China (PRC) and address the regional variability in comparison with the international community.

Methods: The international EL-COVID survey took place online from June 15, 2020 to October 15, 2020. We subtracted and analyzed the data from the PRC participants.

Results: From 84 different countries, PRC had the largest contribution (n = 109, 12.7%). Most of the Chinese responders were experienced vascular surgeons (73.39% vs. 53.81%; p = 0.0001) and attended more than four eL activities (52.29% vs. 54.08%; not significant). Women were underrepresented: 7.33% vs. 23.15%; p = 0.0002. While participation at international activities did not vary, attendance at national eL activities was reduced (27.52% vs. 73.62%, p < 0.0001). Obtaining official accreditation/CME points was relevant in choosing what eL opportunities to attend. Employers were less supportive of participation during working hours (17.43% vs. 46.52%; p < 0,0001).

Conclusion: As in other countries, eL is gaining relevance in the vascular surgery community of PRC. Adequate support as well as improving the dissemination strategy are needed to meet contemporary educational demands

Keywords: e-Learning; Continuing Education; Vascular Surgery

Introduction

The emergence of the World Wide Web has sparked a digital revolution, which expedited global development [1] and infiltrated every aspect of life, including healthcare and educational systems. The concept of "Life Long Learning" emerged as a byproduct of globalization and rendered postgraduate education heavily reliant on online platforms. The contribution of e-Learning (eL) in training and continuous professional development of vascular surgeons remains controversial despite ongoing efforts from a number of institutions to deliver quality online content. The available data is scarce and segmented and does not allow drawing safe conclusions on the real dimension of vascular eL [2-5].

The EL-COVID Survey is the largest international survey to date that investigated the acceptance, effectiveness and limitations of e-Learning in vascular surgery [6-9]. Great regional volatility has been observed amongst participating nations, attributable to complex socio-economic profiles, distinct health system frameworks, preexisting educational platforms and different epidemic curves. This has been addressed by the EL-COVID collaborators in several subgroup analyses [8,9].

In this manuscript we report the data collected in mainland People's Republic of China (PRC) and compare the results to the international cohort, thus complementing the afore mentioned efforts. The study bares a distinctive significance as Chinese participants have been the most numerous in the EL-COVID registry.

Methods

The EL-COVID survey took place from June 15, 2020 to October 15, 2020 and evaluated the appreciation, advantages and disadvantages of vascular eL during the COVID-19 pandemic. Vascular surgeons across the globe were requested to complete an online questionnaire addressing various topics, such as demographics, participants experience and opinion on eL opportunities dedicated to vascular surgery. Exhaustive information on the methodology of the initial survey have been published previously [6]. The survey was approved by the ethics committee of the institution of the primary investigator.

An international panel with expertise on vascular eL was assembled and vascular surgeons with experience in providing education and training were recruited worldwide. The collaborators were asked to disseminate the EL COVID survey at national and regional level. Recruitment was performed through open invitation on various social media (So.Me.) platforms. Several vascular surgeons and trainees were directly contacted via email, sms or telephone.

The official language of the survey was English and the original questionnaire was hosted on Google Forms (Mountain View, CA). A bilingual English-Mandarin version was created, as requested by the Chinese Medical Association, and hosted on SurveyLab (Warsaw, Poland) in order to allow participants from PRC free access.

We subtracted the entries from PRC and compared them to the rest of the participating nations by accessing the EL-COVID registry. Data analysis was performed using MedCalc® free online statistical calculator (MedCalc Software Ltd., Ostend, Belgium, <https://www.medcalc.org/>). The N-1 Chi-squared test was used for comparison of proportions. Significance level was set to alpha = 0.05.

Results

The EL-COVID survey enrolled 1015 participants from 84 different countries [6]. Duplicate entries, malicious content and records of participants that did not attend any online activities were deleted. The remaining 856 records were analyzed and validated.

PRC had the largest contribution to the EL-COVID survey (n = 109, 12.7%), followed by Germany (n = 62, 7.2%), the United States of America (n = 57, 6.7%), Indonesia (n = 52, 6.1%) and Brazil (n = 40, 4.7%). The exhaustive geographical distribution has previously been described [6].

Female participation was significantly lower in PRC in comparison to the international cohort (7.33% vs. 23.15%; p = 0.0002). Participant’s experience level differed significantly in PRC compared to the rest of the nations: the majority consisted of vascular surgeons with more than 5 years of practice (73.39% vs. 53.81%; p = 0.0001), while surgeons with less than 5 years of practice and trainees were underrepresented (Table I).

	PR China (Mainland)	Other nations	Diff.	95% CI*	P*
Gender distribution					
Female	8 (7.33%)	173 (23.15%)	15.8%	8.73 - 20.59	0.0002
Male	100 (91.74%)	573 (76.70%)	15.0%	7.75 - 20.02	0.0003
Non-binary/LGBTQ+	1 (0.91%)	1 (0.13%)	0.8%	-0.19 - 4.87	0.11
Current position					
Vascular surgeon with >5 yrs. of practice	80 (73.39%)	402 (53.81%)	19.6%	9.82 - 27.80	0.0001
Vascular surgeon with <5 yrs. of practice/Fellow	17 (15.59%)	196 (26.23%)	10.6%	2.12 - 17.15	0.0164
Vascular trainee	12 (11.00%)	149 (19.94%)	8.9%	1.20 - 14.44	0.0257

Table I: Gender distribution and current position of survey participants.

Notes: *N-1 Chi-squared test for comparison of proportions. CI: Confidence Interval; Diff.: Difference. Bold numbers: p<0.05.

Most of Chinese responders attended more than four eL activities during the COVID pandemic, consistent with the general findings (52.29% vs. 54.08%; not significant) (Figure 1A). While participation at international activities did not vary (63.30% vs.

71.08%, $p = 0.097$) (Figure 1D), attendance at national eL activities was significantly lower (27.52% vs. 73.62%, $p < 0.0001$) (Figure 1B). Most of the national and international eL opportunities have been officially accredited: 86.66% vs. 47.27% ($p < 0.0001$; Figure 1C) and 89.85% vs. 47.83% ($p < 0.0001$; Figure 1E) respectively.

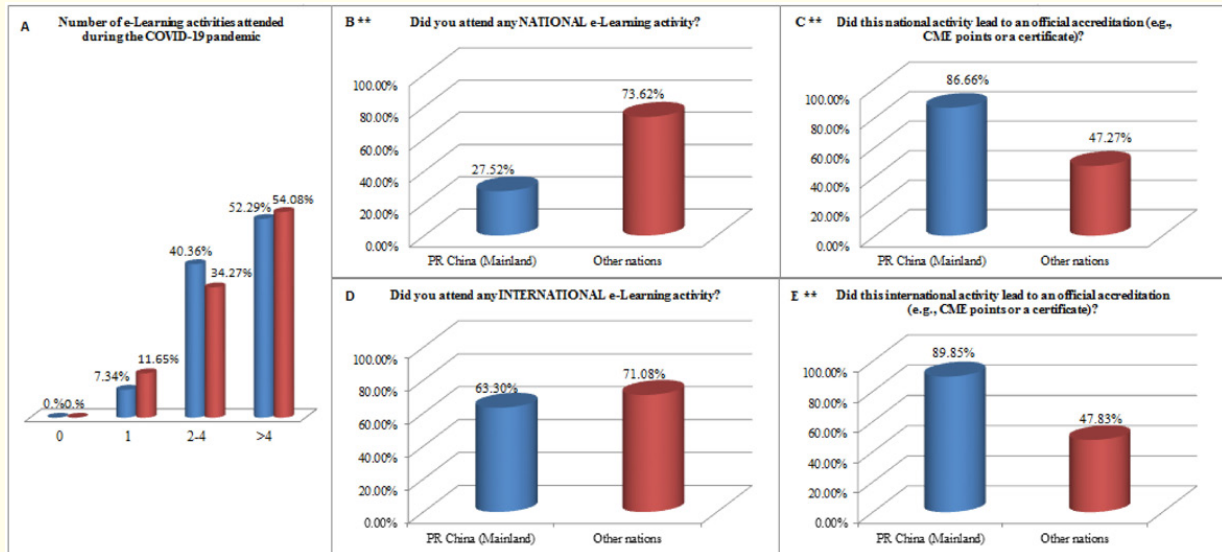


Figure 1

The eL selection criteria did not differ significantly between PRC and the international cohort; the prevailing factor was personal interest (Table II). However, distinctive regional patterns have emerged when promoting these online activities. Vascular surgeons from PRC were less likely to be notified about eL opportunities through national and international societies (27.52% vs. 39.49%; $p = 0.016$). Dissemination through So. Me. as well as actively searching for activities from well-known institutions were significantly expressed in PRC: 44.04% vs. 27.17% ($p = 0.0003$) and 11.93% vs. 5.89% ($p = 0.018$) respectively (Table II).

Compared to the rest of the cohort, Chinese employers were less supportive of attending an eL activity through protected time/allocated time during working hours (17.43% vs. 46.52%; 95% CI [20.35–36.26%]; $p < 0.0001$).

The reasons for not attending eL opportunities also underwent scrutiny. The burden of increased workload and subsequent lack

of time prevailed amongst Chinese participants (60.55% vs. 49%; $p = 0.024$). Time zone difference was however less relevant in PRC (10.09% vs. 19.54%; $p = 0.017$) (Table II).

The overall impression on eL during the COVID-19 pandemic is exemplified in Figure 2A. Most responders rated the activities as positive or very positive, with no significant differences between PRC and the other nations. While the participants found it predominantly easy to retrieve or re-watch a previously attended eL activity (37.61% PRC vs. 54.75% the international cohort; 95% CI [7.11 - 26.37%]; $p = 0.0008$), a significantly larger proportion of Chinese responders found this to be very easy (25.69% vs. 14.31%; 95% CI [3.61-20.6%]; $p = 0.0024$) (Figure 2B).

Most participants in PRC found it significantly more difficult to cite eL activities in a manuscript or a presentation compared to the international cohort (54.12% vs. 31.59%; 95% CI [12.59 - 32.14%];

	PR China (Mainland)	Other nations	Diff.	95% CI*	P*
How did you choose what e-learning activity to attend?					
Based on the reputation of the institution organizing the activity	18 (16.51%)	147 (19.68%)	3.17%	-5.35 - 9.71	0.433
Based on the reputation of the presenter/panel	28 (25.69%)	150 (20.08%)	5.61%	-2.27 - 14.95	0.178
Interested in receiving official accreditation (e.g., CME points)	8 (7.34%)	44 (5.89%)	1.45%	-2.61 - 8.09	0.554
Interested in the activity topic	55 (50.46)	385 (51.54%)	1.08%	-8.80 - 10.10	0.833
Other	0 (0%)	21 (2.81%)	2.81%	-0.73 - 4.26	0.076
How did you find the activities that you have finally attended?					
Through direct contact from national/international society	30 (27.52%)	295 (39.49%)	11.97%	2.30 - 20.28	0.016
Social media	48 (44.04%)	203 (27.17%)	16.87%	7.32 - 26.72	0.0003
Word of mouth	7 (6.42%)	56 (7.50%)	1.08%	-5.39 - 4.98	0.687
Online educational platforms	11 (10.09%)	121 (16.20%)	6.11%	-1.39 - 11.30	0.099
Actively searched for activities from well-known institutions	13 (11.93%)	44 (5.89%)	6.04%	0.84 - 13.6	0.018
Other	0 (0%)	28 (3.75%)	3.75%	0.16v-v5.37	0.039
What was reason for NOT attending an e-Learning activity that you were interested in?					
Lack of time due to increased workload	66 (60.55%)	366 (49%)	11.55%	1.51 - 20.92	0.024
Technical inability (e.g., slow internet connection)	2 (1.83%)	23 (3.08%)	1.25%	-3.47 - 3.25	0.470
Inability to isolate (e.g., crowded home environment during lock-down or busy office)	12 (11.01%)	67 (8.97%)	2.04%	-3.09 - 9.52	0.492
Time-zone difference	11 (10.09%)	146 (19.54%)	9.45%	1.88 - 14.74	0.017
No accreditation	2 (1.83%)	18 (2.41%)	0.58%	-4.11 - 2.49	0.708
No interaction	2 (1.83%)	22 (2.94%)	1.11%	-3.60 - 3.09	0.512
More than one educational activity at the same time	14 (12.84%)	83 (11.11%)	1.73%	-3.87 - 9.57	0.595
Other	0 (0%)	22 (2.94%)	2.94%	-0.61 - 4.41	0.070
n (%)	109 (100%)	747 (100%)			

Table II: Selection and promotion of e-Learning activities and reasons not to attend.

Notes. *N-1 Chi-squared test for comparison of proportions. CI: Confidence Interval; Diff.: Difference. Bold numbers: p < 0.05.

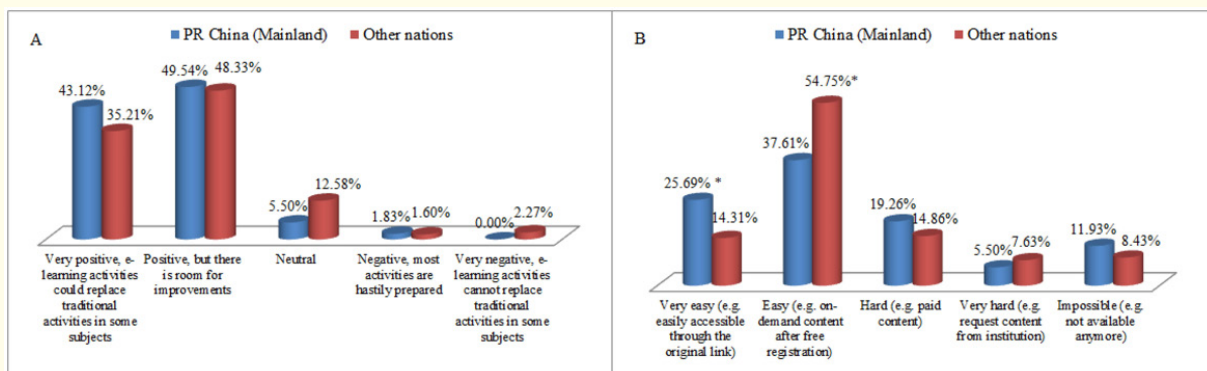


Figure 2

$p < 0.0001$), while a third of them found it to be easy (34.86% vs. 24.36%; 95% CI [1.61 - 20.28%]; $p = 0.019$). Only a minority of Chinese responders would not cite these as a source (11.01% vs. 44.04%; 95% CI [24.97-38.86]; $p < 0.0001$).

The aforementioned eL opportunities were found to be similarly relevant in PRC and in the international community, as the majority of participants would list some of them in their CV/Resume, for example those with CME points or certification (55.96% vs. 52.47%; 95% CI [-6.53 - 13.14%]; $p = 0.49$). Only 22.93% of PRC responders would definitely not list the attended eL activities in their CV/Resume, in accordance with the rest of the participating nations (28.91%; 95% CI [-3.30 - 13.64%]; $p = 0.195$).

Discussion

The Corona Virus Disease (COVID-19) sparked a global public health crisis that acted as a catalyst for the uptake of online education. As lockdown and social distancing measures were implemented around the globe, 46 countries on five different continents announced school closures to contain the spread of COVID-19 as of March 12, 2020. The rest of the world followed soon after. Class Central, the world's top search engine for online courses, has seen a huge surge in traffic and Coursera, the world's largest massive online open course (MOOC) provider, announced that it was offering free online courses in response to COVID-19 [10].

Despite being the first place to be hit by COVID-19, China has enacted a robust centralized epidemic response system, as the authorities battled to understand and contain the new pathogen. Particularly in the wake of the pandemic and in part due to the Zero-COVID policy, the already growing ed-tech and e-learning industry in China surged to fill in the demand for online education. Universities canceled all in-person classes and switched to virtual classrooms as mandated by the "disrupted classes, undisrupted learning" directive of the Ministry of Education [11]. In April 2020, China launched two MOOC platforms - *XuetangX Global* and *iCourse International* - and provided distant e-learning solutions to international learners.

As the world's largest healthcare system is facing the impending consequences of demographic decline and an ageing population, the "Healthy China 2030" initiative was issued and set the education of healthcare professionals at the forefront of this long-

term national strategic plan [12]. The number of higher clinical medicine graduates has steadily increased, with an average annual growth rate of 8.2 % between 2002 and 2018 [13].

Although relevant before the outbreak, the use of eL as avenue for vascular surgery training has grown exponentially during the pandemic period [14,15]. The EL-COVID study is the largest international survey to date that addressed the utility and overall adoption of e-learning in the international vascular surgery community during the COVID 19 pandemic and complements the limited, previously reported data [4,5,15]. Although particularly insightful, there are limited pre-pandemic data to compare our findings.

In our subgroup analysis of the EL-COVID registry, the Chinese vascular surgeons expressed the same interest in online activities as their counterparts, but these eL opportunities have been mostly international. National and international attendance has been positively correlated with proper accreditation (CME points/certificate), which seems to particularly incentivize Chinese physicians, as they are mandated to collect 25 hours of CME credits per year [16]. Furthermore, the research-oriented physician evaluation system exerts overemphasis on scientific activities, this being the main criterion for professional promotion and may indirectly pertain to the observed preference for accredited e-learning opportunities.

Attendance at national e-learning activities was significantly lower in PRC than in the rest of the nations, despite the fact that most of them were awarded an official accreditation. The concept of continuing medical education (CME) was introduced to China in the early 1980s and has since undergone systematic improvement. However, CME activities lacked legal framework and struggled with inconsistencies in form and content for many years [17], which may account for the observed low participation at national online activities. In 2008, the Ministry of Education established the Working Committee for the Accreditation of Medical Education (WCAME), the only agency to accredit medical education programs in China. In 2020, the World Federation for Medical Education (WFME) has recognized WCAME as accreditation body, signaling that the quality of China's standards in medical education and accreditation mechanisms has reached an appropriate and rigorous standard [18].

The demographics in PRC differed significantly to that of the global survey cohort. Chinese participants were mainly senior sur-

geons and male, with junior colleagues and women being significantly underrepresented.

Although there have been many studies on gender inequality in surgery worldwide, there is little to none published literature in China. The World Health Organization reports that the surgical profession is male dominated [19]. According to the Chinese College of Surgeons' "Investigation Report on the Practice Status of Chinese Female Surgeons (2019)", the proportion of female surgeons is increasing, but still only comprises 6.04% of Chinese surgeons, and most of them are residents and attending physicians [20]. Traditional family values make it difficult for Chinese women to exchange the responsibilities of housework, children, and elderly care to those of the professional life. Furthermore, gender bias and reported violence against medical doctors in large hospitals [21] have deterred women from pursuing a surgical career. During the training period in China, it is common for trainees to work for 60–70 h per week, far exceeding the expected work hours (40 h per week). Additionally, the mandatory retirement age is 55 for women and 60 for men. Increased awareness, adopting inclusive measures and eradicating systemic barriers are necessary to close the gender gap in vascular surgery and to address the impeding workforce shortages.

Trainees and vascular surgeons with <5 years of practice/fellows were underrepresented in the Chinese cohort (27.52% vs. 73.62%, $p < 0.0001$), sparking heated debate over access to relevant networking platforms and the percentage of professional opportunities that transpire to the level of junior colleagues. Such a hypothesis warrants however further insight.

The Chinese participants were informed of upcoming eL events through So. Me. or by actively researching what eL activities are available. The role of the national society in information dissemination was underrepresented and this is an aspect that the Chinese Medical Association and the local vascular institutions may consider addressing.

Chinese colleagues could not attend eL activities mainly due to lack of time and increased workload - a finding that is consistent throughout the EL-COVID analysis, as expected during the time of the pandemic. Chinese employees attending eL activities received less support when compared to the international cohort. Enabling

protected/allocated time or educational leave would increase the attendance of eL activities, subsequently enhancing the professional skills and knowledge of vascular surgeons and trainees, as well as further improving patient care.

A comparison between PRC and international results has to be viewed with caution, as the reported data are derived from an observational study, thus incurring several limitations. The selected dissemination strategy on social media and personal communications over email, direct message or telephone may have contributed to an ununiform accrual process. Various factors may potentially contribute to the observed gender and training status disparities, such as preexisting e-Learning platforms as well as familiarity with eL of participating vascular surgeons. Although the survey was designed to transparently and equitably reach broad communities of vascular surgeons internationally, selection bias and potential clustered data cannot be excluded. As the generated data and published results may be subject to debate, the EL-COVID is the first international study on vascular e-Learning of this size that fundamentally contributed to a better understanding of the contemporary needs of the vascular surgeon.

Conclusion

As previously documented internationally [3,4,6,8,9], overall appreciation and avid adoption of eL activities also prevailed in the Chinese community of vascular surgeons. Institutional support as well as a more active role of the national vascular societies in disseminating information of upcoming educational and training eL opportunities are needed in order to facilitate online continuous professional development in PRC.

Acknowledging the diversity of various health systems worldwide enhances international collaboration, facilitates borderless access to medical education and subsequently enables equitable access to healthcare, concepts that define the new megatrend towards "Global Health Governance" [22,23].

Statements and Declarations

The authors have no competing interests to declare that are relevant to the content of this article.

Ethics Approval

This is an observational study. No ethical approval is required.

Author Contributions

- **Conceptualization:** Nikolaos Patelis, Zaiping Jing, Jiaxuan Feng;
- **Methodology:** Nikolaos Patelis, Zaiping Jing, Jiaxuan Feng;

Formal Analysis and Investigation

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- Writing - original draft preparation: Oana Bartos, Nikolaos Patelis;
- Writing - review and editing: Oana Bartos, Nikolaos Patelis, Matthias Trenner.
- All authors have read and approved the final manuscript.

Data Availability Statement

The datasets analysed during the current study are available from the corresponding author on reasonable request.

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