ISSN 2522-6398 Vol. 6, Issue 3: 7-15, DOI: 10.25236/FER.2023.060302

Urological Online Learning through WeChat in China: Lessons from the Covid-19 Pandemic

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Abstract: *A public platform named Jiujing for the urologists' online learning on the most popular social media WeChat in China was founded in 2015. Backend database from Jiujing before and during Covid-19 pandemic were compared and analyzed. An online questionnaire investigation containing 482 respondents was carried out to evaluate the personal characteristics and online learning preferences of Chinese urologists. During the epidemic of Covid-19, the amounts of national subscribers in Jiujing platform increased by 26.24%, while the constituent ratio of subscribers' quantity from Hubei province decreased although there were 189 new subscribers, and only surgery video section experienced increased constituent ratio of subscribers' concerns. Most respondents experienced whittled offline learning opportunities and boosted online learning demands during Covid-19 pandemic as online self-learning was more efficiency. Surgery videos and academic lectures were the most popular sections. Urologists' viewpoints towards online learning are associated with professional post, affiliation hierarchy and education background.*

Keywords: *online education, social media, urology, WeChat, Covid-19*

1. Introduction

The last decade has witnessed the rapid development of the Internet, which has remarkably changed our lifestyle. In China, WeChat is a popular social application on both the web and mobile, which contains multiple functions like text and voice messages, group chats, subscriptions to public accounts, mobile payments, and video calls [1]. The economic growth in China led to a growing structural imbalance of talent in the sense that the number of professional technical talents are insufficient to meet citizen demand [2]. The urban-rural gap has also suffered greatly from the shortage and unbalanced distribution of high-quality medical resources, especially the disequilibrium in technological capacities of medical practitioners [3].

The applications of social media in healthcare and its role in scientific communication provide great opportunities for the urological community [4]. Consequently, urologists around the world have been using social media for business affairs, academic conferences, and health providing [5]. Meanwhile, the development of new media has also greatly improved the traditional modes of education, which helped correct the imbalance between the number of doctors and patients. In particular, the outbreak of Covid-19 has restricted face-to-face learning and significantly promoted transformation of medical continuing education patterns [6].

A group of urologists from different cities and affiliations in China founded an academic platform using a WeChat account named Jiujing, which means exploring the art of urological endoscope in Chinese pinyin. It provides an open, accessible, and generally shared academic platform aimed at promoting skills, innovating perceptions, and serving both professionals and residents. Since its

ISSN 2522-6398 Vol. 6, Issue 3: 7-15, DOI: 10.25236/FER.2023.060302

establishment on December 15th in 2015, nearly 700 messages have been released by Jiujing through WeChat. Over 50 public lectures have been broadcasted online and nearly 8,000 participants have joined 18 chat groups. The platform provides the users with updates on the newest literature, humane care, free online lectures or surgery videos, difficult or special case discussions, and exchanges on academic opinions. Urologists and related practitioners are encouraged to share their clinical experience, surgery videos, or research reports through the platform. Editors from the platform will also invite related specialists to give commonwealth online lectures, which has gained more than 13,000 followers. In this way, advanced concepts and ideas are disseminated with no regard for geographical and qualification barriers among the urologists.

The pandemic of Covid-19 has hastened the transition to online medical learning. In line with this, some structural alterations of the subscribers in Jiujing platform have been noticed. Consequently, we carried out an online questionnaire investigation to explore the characteristics of online learners among urologists and their learning interests through WeChat during the Covid-19 pandemic.

2. Materials and methods

2.1. Data acquisition and descriptive analysis from WeChat platform

Data of subscribers to the Jiujing platform were obtained from the backend database of WeChat Media Platform (https://mp.weixin.qq.com/). General information of the subscribers including gender, age, region, and language were collected. Distributions of the subscribers' regions and click volume of each section in the platform before (data by the end of 2019) or during (data by the end of 2020) the epidemic of Covid-19 were compared. The backend database did not contain personal information details of the subscribers, and the analysis of the data was automatically performed by the platform.

2.2. Online survey on urologists' self-learning through WeChat during Covid-19 pandemic

The online survey on online urological learning through WeChat during the Covid-19 pandemic was carried out through the online questionnaire instrument WENJUANXIN (https://www.wjx.cn/), which is a platform for professional online surveying, evaluation, and voting in China [7]. A statement was included in the questionnaire such that the respondents indicated their consent to participate in the study once they submitted the questionnaire. The electronic questionnaires containing 11 questions (10 single choice and 1 multiple choice) were sent to the urologists subscribed to the Jiujing platform via WeChat. General information questions included gender (item 1), title (item 2), degree (item 3), hierarchy of affiliation (item 4), whether they were from a teaching hospital (item 5), whether they worked as frontline staff against Covid-19 (item 6). The attitudinal questions concerned the influence of Covid-19 on face-to-face learning opportunities (item 7) and online learning demands (item 8), an efficiency comparison between face-to-face and online learning (item 9), whether they benefited from online learning (item 10), and what the most beneficial sections were (item 11, multiple choice).

2.3. Statistical analysis

Data were presented as numbers with percentages (n, %). Descriptive analysis of the data from WeChat platform was performed with Microsoft Excel (2019 edition). Logistic regression analysis and chi-square test of the investigation data were analyzed using the online software SPSSAU (version 20.0, retrieved from https://www.spssau.com) [8]. The $*p$-value < 0.05 or $**p$-value < 0.01 were considered statistically significant.

3. Results

3.1. Impacts of Covid-19 pandemic on distributions and preferences of the subscribers in Jiujing platform

According to the backend database from WeChat, by the end of 2020, about 22,000 individuals were following the account with total views approaching 2.4 million. The distribution of languages used by the subscribers were Chinese (98.81%), English (1.01%), and other (0.18%). Approximately 84.88% of the subscribers were male, and 74.68% of them were 26 to 45 years old.

The amounts of subscribers increased by 26.24% during the Covid-19 epidemic. As in Figure 1A,

ISSN 2522-6398 Vol. 6, Issue 3: 7-15, DOI: 10.25236/FER.2023.060302

before the Covid-19 pandemic, the top five provinces in terms of user distribution were Guangdong (9.68%), Hunan (7.02%), Shandong (6.40%), Hubei (6.11%). and Henan (5.99%). As in Figure 1B, during the Covid-19 pandemic, the top provinces in terms of user distribution were Guangdong (10.29%), Hunan (8.39%), Shandong (6.31%), Jiangsu (5.82%), Henan (5.52%), Sichuan (5.43%) and Hubei (5.38%) (Fig 2). Although there were 189 new subscribers from Hubei, the province hardest hit by the Covid-19 epidemic, it has witnessed a decreased constituent ratio of subscriber quantity. Simultaneously, only the surgery video section experienced an increased constituent ratio of subscribers (according to the data of browsing frequency), while constituent ratios of academic lectures, case reports, medical humanity, online interaction, and the literature update sections decreased (Figure 1C).

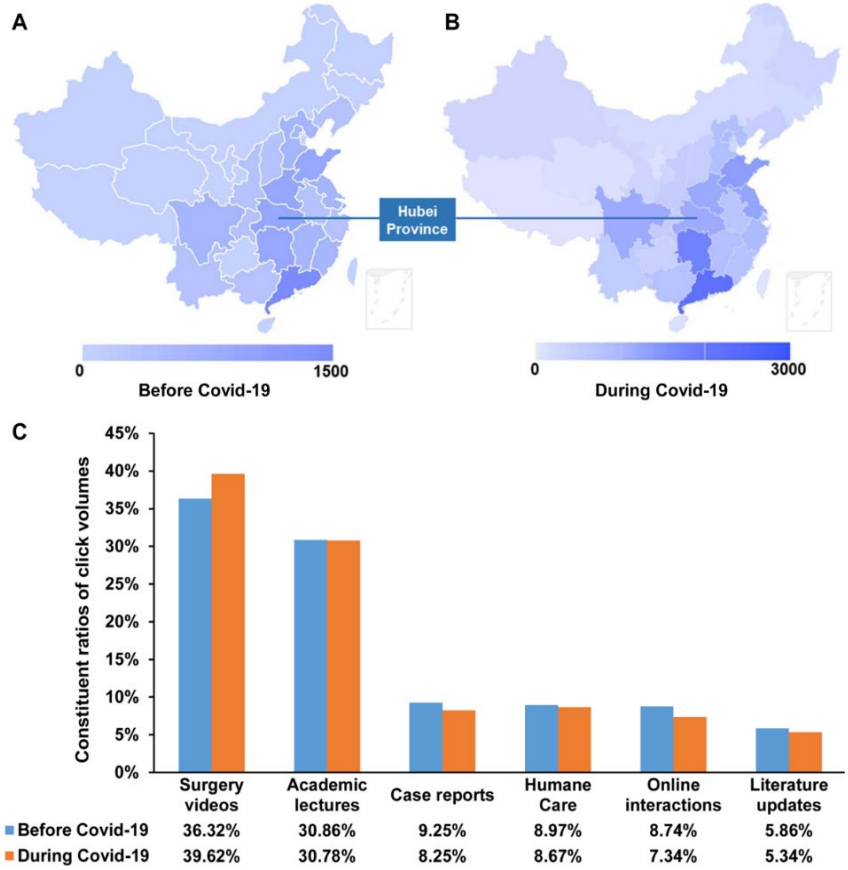

Figure 1: Impacts of Covid-19 pandemic on distributions and preferences of the subscribers in Jiujing platform. (A) Region distribution of the subscribers before Covid-19 pandemic (data by the end of 2019). (B) Region distribution of the subscribers during Covid-19 pandemic (data by the end of 2020). (C) Constituent ratios of click volumes in each section of the platform before and during Covid-19 pandemic

3.2. Convert of self-learning among Chinese urologists through WeChat during Covid-19 pandemic

A total of 482 valid questionnaires were received and the general information of the respondents are presented in Table 1. Most of the respondents experienced reduced face-to-face learning opportunities (364/482, 75.52%) which led to increased online learning demands (413/482, 85.68%) during the Covid-19 pandemic. Compared with face-to-face learning (168/482, 34.85%), more respondents considered online learning (215/482, 44.61%) to be more effective. An overwhelming majority (466/482, 96.68%) acknowledged that they have benefited from online learning though the WeChat platform during the Covid-19 pandemic. Among the personal characteristics, the differences of the respondents' positional titles remarkably impacted their choices (Table 2). The greater their qualifications, the more significantly the respondents suffered from decreased face-to-face learning opportunities (64.29% of primary physicians, 74.05% of attending physicians, 80.37% of assistant director physicians, 79.69% of director physicians), and the more they regarded face-to-face learning as the more effective learning manner (25.71% of primary physicians, 30.81% of attending physicians, 39.88% of assistant director physicians, 43.75% of director physicians).

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Table 1: General information of the respondents (n, %).

Items		Values
Gender	Male	461 (95.64)
	Female	21(4.36)
Title	Director physician	64 (13.28)
	Assistant director physician	163 (33.82)
	Attending Physician	185 (38.38)
	Primary physician	70 (14.52)
Degree	Doctor	61 (12.66)
	Master	142 (29.46)
	Bachelor	257 (53.32)
	Associate	22 (4.56)
Affiliation Hierarchy	National or ministerial level	29 (6.02)
	Provincial or municipality level	89 (18.46)
	City level	163 (33.82)
	Level of county and below	201 (41.70)
Teaching hospital staff	Yes	306 (63.49)
	No	176 (36.51)
Frontline staff against COVID-19 [a]	Yes	144 (29.88)
	No	338 (70.12)

[a] Official definition of China: those who have directly participated in the diagnosis, treatment, examination, transport, nursing, epidemiological survey and specimen collection of the confirmed or suspected cases with Covid-19.

Table 2: Viewpoints from urologists with different backgrounds towards self-learning through WeChat during Covid-19 pandemic (n, %).

Items		Face-to-face learning opportunity			Online learning demand			More effective manner			Benefit from online learning	
		Increased	Decreased	Unchanged	Increased	Decreased	Unchanged	Online	Face-to-face	Indiscrimination	Yes	No
Gender	Male	80(17.35)	350(75.92)	31(6.72)	395(85.68)	15(3.25)	51(11.06)	202(43.82)	162(35.14)	97(21.04)	446(96.75)	15(3.25)
	Female	4(19.05)	14 (66.67)	3(14.29)	18(85.71)	0(0.00)	3(14.29)	13(61.90)	6(28.57)	2(9.52)	20(95.24)	1(4.76)
	χ^2		1.889			0.87			3.019		0.142	
	p		0.389			0.647			0.221		0.706	
Title□	Director physician	11(17.19)	51(79.69)	2(3.13)	50(78.13)	3(4.69)	11(17.19)	19(29.69)	28(43.75)	17(26.56)	63(98.44)	1(1.56)
	Assistant director physician	19(11.66)	131(80.37)	13(7.98)	140(85.89)	5(3.07)	18(11.04)	71(43.56)	65(39.88)	27(16.56)	160(98.16)	3(1.84)
	Attending Physician	39(21.08)	137(74.05)	9(4.86)	163(88.11)	6(3.24)	16(8.65)	91(49.19)	57(30.81)	37(20.00)	178(96.22)	7(3.78)
	Primary physician	15(21.43)	45(64.29)	10(14.29)	60(85.71)	1(1.43)	9(12.86)	34(48.57)	18 (25.71)	18(25.71)	65(92.86)	5(7.14)
	χ^2		15.098			5.012			12.853		5.039	
	p		**0.020***			0.542			**0.045***		0.169	
Degree	Doctor	13(21.31)	44(72.13)	4(6.56)	56(91.80)	2(3.28)	3 (4.92)	27(44.26)	17(27.87)	17(27.87)	60(98.36)	1(1.64)
	Master	26(18.31)	105(73.94)	11(7.75)	115(80.99)	5(3.52)	22(15.49)	72(50.70)	44(30.99)	26(18.31)	134(94.37)	8(5.63)
	Bachelor	42(16.34)	200(77.82)	15(5.84)	222(86.38)	8(3.11)	27(10.51)	105(40.86)	102(39.69)	50(19.46)	252(98.05)	5(1.95)
	Associate	3(13.64)	15(68.18)	4(18.18)	20(90.91)	0(0.00)	2(9.09)	11(50.00)	5(22.73)	6(27.27)	20(90.91)	2(9.09)
	χ^2		5.943			6.166			8.826		6.701	
	p		0.43			0.405			0.184		0.082	
Affiliation Hierarchy	National / ministerial	7(24.14)	20(68.97)	2(6.90)	26(89.66)	1(3.45)	2(6.90)	14(48.28)	9(31.03)	6(20.69)	29(100.00)	0(0.00)
	Provincial / municipality	13(14.61)	73(82.02)	3(3.37)	78(87.64)	4(4.49)	7(7.87)	37(41.57)	31(34.83)	21(23.60)	83(93.26)	6(6.74)
	City	31(19.02)	121(74.23)	11(6.75)	134(82.21)	4(2.45)	25(15.34)	81(49.69)	53(32.52)	29(17.79)	158(96.93)	5(3.07)
	County / below	33(16.42)	150(74.63)	18(8.96)	175(87.06)	6 (2.99)	20 (9.95)	83(41.29)	75(37.31)	43(21.39)	196(97.51)	5(2.49)
	χ^2		4.994			5.296			3.513		4.709	
	p		0.545			0.507			0.742		0.194	
Teaching hospital staff	Yes	52(16.99)	231(75.49)	23(7.52)	262(85.62)	7(2.29)	37(12.09)	140(45.75)	103(33.66)	63(20.59)	294(96.08)	12(3.92)
	No	32(18.18)	133(75.57)	11(6.25)	151(85.80)	8(4.55)	17(9.66)	75(42.61)	65(36.93)	36(20.45)	172(97.73)	4(2.27)
	χ^2		0.345			2.421			0.591		0.947	
	p		0.842			0.298			0.744		0.331	
Frontline staff	Yes	26(18.06)	107(74.31)	11(7.64)	121(84.03)	6(4.17)	17(11.81)	59(40.97)	55(38.19)	30(20.83)	142(98.61)	2(1.39)
	No	58(17.16)	257(76.04)	23(6.80)	292(86.39)	9(2.66)	37(10.95)	156(46.15)	113(33.43)	69(20.41)	324(95.86)	14(4.14)
	χ^2		0.186			0.866			1.274		2.385	
	p		0.911			0.648			0.529		0.123	

*p < 0.05, **p < 0.01; OR: odds ratio, CI: confidence interval.

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Table 3: Logistic regression analysis of selected beneficial sections regarding online urological learning through WeChat.

Dependent variable	Independent variable	Regression coefficient	Standard error	z value	Wald χ^2	*p*	OR	OR 95% CI
Surgery videos	Gender	-0.654	0.687	-0.952	0.907	0.341	0.520	0.135 ~ 1.999
	Title	-0.297	0.218	-1.361	1.853	0.173	0.743	0.484 ~ 1.140
	Degree	-0.329	0.306	-1.077	1.160	0.281	0.719	0.395 ~ 1.310
	Affiliation Hierarchy	0.699	0.256	2.726	7.434	**0.006****	2.012	1.217 ~ 3.327
	Teaching hospital staff	-0.092	0.451	-0.203	0.041	0.839	0.912	0.377 ~ 2.210
	Frontline staff	0.046	0.420	0.110	0.012	0.913	1.047	0.459 ~ 2.387
Academic lectures	Gender	0.107	0.664	0.161	0.026	0.872	1.113	0.303 ~ 4.094
	Title	-0.194	0.166	-1.167	1.362	0.243	0.823	0.594 ~ 1.141
	Degree	-0.383	0.248	-1.549	2.399	0.121	0.681	0.420 ~ 1.107
	Affiliation Hierarchy	0.309	0.204	1.513	2.290	0.130	1.361	0.913 ~ 2.030
	Teaching hospital staff	-0.175	0.321	-0.545	0.297	0.586	0.840	0.448 ~ 1.575
	Frontline staff	0.183	0.310	0.591	0.349	0.555	1.201	0.655 ~ 2.203
Case reports	Gender	2.400	1.037	2.315	5.360	**0.021***	11.022	1.445~ 84.073
	Title	0.131	0.109	1.202	1.446	0.229	1.140	0.921 ~ 1.411
	Degree	0.309	0.167	1.855	3.442	0.064	1.362	0.983 ~ 1.889
	Affiliation Hierarchy	-0.074	0.142	-0.521	0.271	0.602	0.929	0.704 ~ 1.226
	Teaching hospital staff	0.168	0.216	0.776	0.602	0.438	1.183	0.774 ~ 1.807
	Frontline staff	0.000	0.209	-0.001	0.000	1.000	1.000	0.664 ~ 1.505
Humane care	Gender	0.503	0.478	1.052	1.107	0.293	1.654	0.648 ~ 4.226
	Title	0.276	0.126	2.189	4.791	**0.029***	1.318	1.029 ~ 1.688
	Degree	0.291	0.190	1.535	2.357	0.125	1.338	0.923 ~ 1.942
	Affiliation Hierarchy	-0.039	0.158	-0.245	0.060	0.807	0.962	0.705 ~ 1.312
	Teaching hospital staff	-0.025	0.241	-0.102	0.010	0.918	0.976	0.608 ~ 1.566
	Frontline staff	0.133	0.241	0.552	0.304	0.581	1.142	0.713 ~ 1.830
Online interactions	Gender	0.925	0.514	1.799	3.236	0.072	2.523	0.920 ~ 6.916
	Title	-0.121	0.109	-1.112	1.237	0.266	0.886	0.715 ~ 1.097
	Degree	0.375	0.167	2.246	5.045	**0.025***	1.455	1.049 ~ 2.017
	Affiliation Hierarchy	-0.211	0.140	-1.508	2.274	0.132	0.809	0.615 ~ 1.065
	Teaching hospital staff	-0.111	0.212	-0.524	0.274	0.600	0.895	0.590 ~ 1.356
	Frontline staff	0.321	0.208	1.546	2.389	0.122	1.378	0.918 ~ 2.070
Literature updates	Gender	0.311	0.480	0.648	0.419	0.517	1.365	0.532 ~ 3.499
	Title	0.370	0.116	3.186	10.154	**0.001****	1.447	1.153 ~ 1.816
	Degree	0.044	0.170	0.257	0.066	0.797	1.045	0.748 ~ 1.459
	Affiliation Hierarchy	-0.307	0.145	-2.113	4.463	**0.035***	0.736	0.554 ~ 0.978
	Teaching hospital staff	-0.431	0.226	-1.906	3.632	0.057	0.650	0.417 ~ 1.012
	Frontline staff	-0.160	0.215	-0.743	0.552	0.458	0.852	0.559 ~ 1.299

*p < 0.05, **p < 0.01; OR: odds ratio, CI: confidence interval.

ISSN 2522-6398 Vol. 6, Issue 3: 7-15, DOI: 10.25236/FER.2023.060302

3.3. Impacts of personal characteristics on urological online learning preferences through WeChat in China

In accordance with the backend database of Jiujing platform, the online investigation also revealed that surgery videos (450/482, 93.36%) and academic lectures (425/482, 88.17%) were the most popular sections (Figure 2A). As in Table 3, logistic regression analysis showed that affiliation hierarchy significantly influenced the respondents' preferences in surgery videos and literature updates, while titles of the respondents remarkably impacted their preferences in humane care and literature updates. Additionally, degree and gender respectively affected their favors in online interactions and case reports.

With the upgrading of affiliation hierarchy, the preferences for surgery videos and literature updates accordingly decreased (Figure 2B). As illustrated in Figure 2C, respondents with intermediate positional titles (attending physician and assistant director physician) were more interested in medical humanities and literature updates. Meanwhile, respondents with Bachelor degrees (128/225, 56.89%) accounted for the majority in favor of online interactions (Figure 2D).

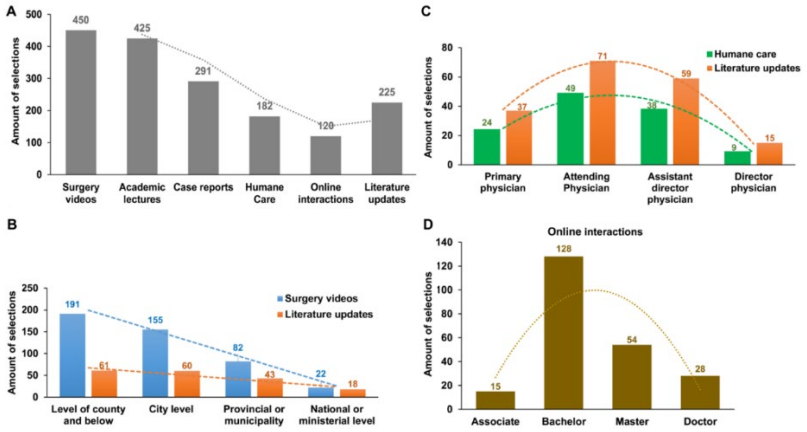

Figure 2: Impacts of personal characteristics on urological online learning preferences through WeChat. (A) Amounts of selections on each beneficial section in WeChat platform. (B) Amounts of selections from respondents with different affiliation hierarchies on surgery videos and literature updates sections. (C) Amounts of selections from respondents with different positional titles on humane care and literature updates sections. (D) Amounts of selections from respondents with different degrees on online interactions.

4. Discussion

According to the 47th China Statistical Report on Internet Development (data available at http://www.cnnic.net.cn/hlwfzyj/hlwxzbg/hlwtjbg/202102/P020210203334633480104.pdf), the amount of online education users in China increased to 109 million by the end of 2020 compared to the year 2019. The Covid-19 pandemic is forcing medical educators to re-evaluate how to educates learners of all levels [9]. Travel restrictions led to a preference for online meetings in urological associations despite the irreplaceability of face-to-face meetings [10]. Therefore, continuing education in the time of social distancing has drawn our attention to social media such as Twitter, which have been widely used in education and conferences sharing among global urological communities [11]. Online urological learning is no exception - urologists have adopted web-based platforms to develop virtual education programs to fill the gap [12]. Young and junior physicians need to learn more while expert and senior specialists want to teach more, so they get together and communicate online through social media.

As one of the most popular social media applications in China, WeChat has been playing an important role in online medical education [13]. According to our data, online urological learning through WeChat became more popular during the Covid-19 pandemic in China. Afterwards, we conducted an online questionnaire survey to explore the characteristics of online learners among urologists and their learning interests on WeChat during the Covid-19 pandemic. As expected, a majority of the respondents experienced decreased face-to-face learning opportunities during the Covid-19 pandemic, which led to an increase in online learning demands. It was reassuring that most urologists have benefited from online learning including those who have directly participated in the battle against Covid-19. However, compared with veteran senior physicians (director physicians), online learning was significantly more

ISSN 2522-6398 Vol. 6, Issue 3: 7-15, DOI: 10.25236/FER.2023.060302

beneficial for the juniors (primary and attending physicians).

A systematic review has indicated that Internet and software-based platforms for surgical training is just as effective as other methods of training, but technical and infrastructural resources is still a major challenge for implementing online learning [14, 15]. Understanding the various demands of users with different backgrounds is particularly important when building an online learning platform. Whether the respondents worked at a teaching hospital or as frontline staff against Covid-19 had no effect on their viewpoints. Given that medical students used to be engaged and motivated when being taught with video [16], it should come as no surprise that surgery videos, and academic lectures were the most popular sections in both the Jiujing platform and the questionnaire results. Consistent with a previous study, the subscribers tended to pay more attention to the surgery video sections, which is a result of the decrease in quantity of operations during the Covid-19 epidemic [12]. Since most users of social medias are young adults, the decreased quantity of operations is supposed to cause decreased practice opportunities, especially for the inexperienced surgeons. However, the imbalance of learning resources due to regional discrepancies has led to different attitudes towards online education [17]. The benefits of the surgery video and literature update sections decreased with the hierarchical ascension of the respondents' affiliations. As surgery videos and literature resources were less accessible to the physicians working in grassroot hospitals, urologists at these institutions might benefit more from online learning than those in provincial or national hospitals.

With the rapid development of medical science, online learning is a complementary and essential way to update knowledge for continuing education [18]. Compared to natural science courses, a dreary teaching style has led to limited attention being paid to humane care in the Chinese medical education system although it has some merits: mandatory education in the early semester and only meeting basic educational goals [19]. When faced with the tension between doctors and patients, we are required to optimize our professional knowledge as well as humanistic care. Our study uncovered that online learning of literature and medical humanities were considered significantly beneficial among attending doctors and assistant director physicians, who usually bear the main responsibilities of communicating with the patients in Chinese hospitals.

In order to meet the huge demand for doctors while ensure a basic minimum of quality, medical education in China used to be classified into different program durations: associate with 3 years (licensed assistant doctors), bachelor with 5 years (licensed general practitioner), master with 3 more years (licensed residency), and doctor with another 3 more years (licensed specialist physicians) [20, 21]. In the earlier years, medical undergraduates in China could work as licensed doctors in hospitals without systematic education and training as specialist physicians, so they obtained specialty knowledge in urology mainly via self-learning and communication with colleagues. It is no wonder that in our investigation, the benefits of online interaction were associated with the degree of respondents: urologists with a Bachelor degree exhibited the most enthusiasm. A previous systematic review and meta-analysis revealed that face-to-face learning was no better than online learning in undergraduate medical education, but online learning was better for enhancing undergraduates' knowledge and skills [22].

As one of the most popular urological online learning platforms on WeChat, Jiujing has established a well-developed editorial system. Academic advisers (famous experts), executive editors (co-founders of the platform) and corresponding editors (young scholars) compose the editorial board of Jiujing platform, and they work without pay. The editors invite well-known urological experts or medical teams to give online academic lectures, as well as submit case reports or critical reviews. On the other hand, Jiujing accept independent contributions, and all the submissions are supposed to be reviewed by at least two editorial board members before online publication. Meanwhile, Jiujing has held series of case sharing and surgical video competitions nationwide, and the excellent cases and videos will be collected and commented by top experts. Eventually, a book containing those cases and specialists' opinion will be published (Figure 3). Admittedly, our work has some limitations. There are other WeChat platforms for urological online learning in China, but we were not able to include them in our study due to the lack of consistent and comparable backend data of these platforms. Given that the online questionnaires were randomly given out through WeChat and collected from the target respondents, we can conclude that the factors mentioned above modestly restricted the representativeness of the data.

ISSN 2522-6398 Vol. 6, Issue 3: 7-15, DOI: 10.25236/FER.2023.060302

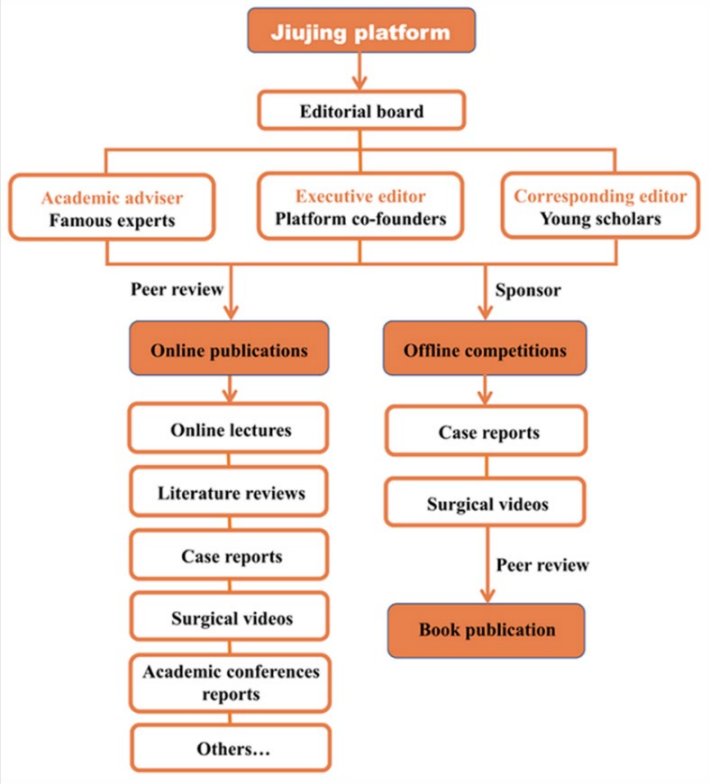

Figure 3: Organizational structure and academic sections of Jiujing platform.

5. Conclusion

Even though the outbreak of Covid-19 has affected the patterns of urological self-learning to a certain degree and the long-term impact of the pandemic on medical education remains unknown, urologists in China have benefited a lot from what they learned on WeChat. The present work also suggests that when establishing an online surgery education platform, the background of target audiences such as gender, title, degree, and affiliation hierarchy should be taken into consideration. Additionally, surgery videos and academic lectures are popular content types to be leveraged.

Ethics statement: This study was approved by Medical Ethics Committee of the Xiangya Hospital of Centre South University and conducted in accordance with the Helsinki Declaration. All methods were carried out in accordance with relevant guidelines and regulations.

Conflict of interest: The authors declared no competing interests.

Funding: This study was supported by Education and Teaching Reform Research Project of Central South University (No. 2020jy149-2) to Longfei Liu.

Acknowledgments

The authors give thanks to Shaoxiong Ming, Xiande Cao, Daozhang Yuan, ZhaoWang, Ming Yi, Xing Zhang, Meng Zhang, Jian Li, Xiao Guan, Jinzhuo Ning, Yongpeng Xie, Luyao Chen for the academic support of this work.

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