

BMJ Open Oncological big data platforms for promoting digital competencies and professionalism in Chinese medical students: a cross-sectional study

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ABSTRACT

Objectives Advancements in big data technology are reshaping the healthcare system in China. This study aims to explore the role of medical big data in promoting digital competencies and professionalism among Chinese medical students.

Design, setting and participants This study was conducted among 274 medical students who attended a workshop on medical big data conducted on 8 July 2021 in Tongji Hospital. The workshop was based on the first nationwide multifunction gynecologic oncology medical big data platform in China, at the National Union of Real-World Gynecologic Oncology Research & Patient Management Platform (NUWA platform).

Outcome measures Data on knowledge, attitudes towards big data technology and professionalism were collected before and after the workshop. We have measured the four skill categories: doctor–patient relationship skills, reflective skills, time management and interprofessional relationship skills using the Professionalism Mini-Evaluation Exercise (P-MEX) as a reflection for professionalism.

Results A total of 274 students participated in this workshop and completed all the surveys. Before the workshop, only 27% of them knew the detailed content of medical big data platforms, and 64% knew the potential application of medical big data. The majority of the students believed that big data technology is practical in their clinical practice (77%), medical education (85%) and scientific research (82%). Over 80% of the participants showed positive attitudes toward big data platforms. They also exhibited sufficient professionalism before the workshop. Meanwhile, the workshop significantly promoted students' knowledge of medical big data ($p < 0.05$), and led to more positive attitudes towards big data platforms and higher levels of professionalism.

Conclusions Chinese medical students have primitive acquaintance and positive attitudes toward big data technology. The NUWA platform-based workshop may potentially promote their understanding of big data and enhance professionalism, according to the self-measured P-MEX scale.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study depicted the knowledge and professionalism of medical big data among Chinese medical students in the era of big data for the first time.
- ⇒ This study provided a vivid example of how big data can assist medical education, based on the first nationwide gynecologic oncology medical big data platform in China (NUWA platform).
- ⇒ The generalisation of the findings is limited by the lack of sample representation and the short follow-up time.

BACKGROUND

Electronification of medical records is the signature of the modern healthcare system.^{1–3} Massive clinical and omics data have been produced to enable more detailed depictions of patients and diseases. Medical big data are thus reshaping our appreciation of the modern medical system. Technological advancements in data storage, processing and analysis accelerated the clinical application of big data-driven products and contributed to personalised disease management,^{4 5} early diagnosis^{6–8} and treatment decision.^{9 10} Especially in the COVID-19 pandemic setting, achieving rapid application of medical big data would meet the pressing clinical need to predict the progression of diseases using data characteristics.^{11–13}

Big data have brought new challenges for doctors.¹⁴ Information overload is a challenge for every healthcare worker, since they have to acclimate to the nature of big data, including extraordinary value, volume, velocity, variety and variability.¹⁵ Challenges can also be expected regarding medical professionalism in the age of big data. Because big data values realistic health-related information more than ever, the illusion that digital data

outweigh face-to-face physician–patient interactions may motivate doctors to ignore the importance of professionalism.^{16 17} There is no precise definition of medical professionalism, which is reflected in the attitudes and behaviours directly related to clinical practice. Epstein and Hundert proposed the definition of professional competence as wisely using communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice.¹⁸ And Cain *et al* summarised professionalism as a series of attributes, such as altruism, respect, honesty and so on.¹⁹ Some studies have shown that digital medical education based on big data plays a positive effect in promoting professionalism.^{16 20 21} However, there is a lack of research on the attitudes and professionalism of Chinese healthcare workers regarding medical big data. Therefore, extra lectures and workshops about obtaining insights into big data and remaining respectful to patients are necessary.

In this study, we aimed to depict the knowledge of medical big data and professionalism in the era of big data among Chinese medical students. What is more, we conducted a workshop for Chinese clinical and preclinical students to improve their knowledge of medical big data and their professionalism in the big data era, based on the National Union of Real-World Gynecologic Oncology Research & Patient Management Platform (NUWA platform), which is the first nationwide multifunction gynecologic oncology medical big data platform in China.

METHODS

Study design

A workshop on the introduction of medical big data was conducted among clinical and preclinical students in Tongji Medical School. We conducted this study on Chinese medical students' learning and the application of big data in healthcare using precourse and postcourse questionnaires.

Workshop design

The workshop was conducted on 8 July 2021 in Tongji Hospital, Tongji Medical School, Huazhong University of Science and Technology, Wuhan, China. It was part of the series class of 'Medical big data platforms learning and applying'.

The workshop was delivered by two senior doctors (QLG and SQZ), who have over 5 years of experience in medical big data platforms development and application. The workshop consisted of three major parts: (1) a lecture on the content and application of medical big data; (2) a lecture on professionalism for doctors in the big data era; and (3) learners being allowed to explore the NUWA platform freely according to their interest. The first and second sections lasted for approximately 45 min, and the third section lasted for 30 min.

In section one, five major parts were included in lectures given by the senior doctors, (1) the development of medical big data in China and the world, (2)

the application and potential of big data in clinical practice, medical education and scientific research, (3) the construction and content of the NUWA platform, (4) how to use the NUWA platform, and (5) plans for the NUWA platform development. For the second section, the following four items were discussed: (1) the attitude healthcare workers should have when communicating with patients and colleagues, considering that big data have already reshaped our medical system, (2) the importance of detailed and continuous patient information for the development of big data platforms, (3) how to protect patient privacy on the databases, and (4) how to use the NUWA platform to satisfy patients' needs. For Section 3, all students were given a temporary account for the NUWA platform and had access to all deidentified patient information. They were allowed to explore the medical data freely and view structured healthcare information for half an hour.

Data collection

Clinical and preclinical students in Tongji Medical School were invited to attend a 2-hour class by email or roadshows between 8 June 2021, and 7 July 2021. The contents and speakers for the workshop were presented in the email or during the roadshow. In addition, all fifth-grade (n=50, preclinical) and sixth-grade (n=49, clinical) students of 8-year undergraduate education in Tongji Medical School took part in this workshop as an additional course.

The participants completed two surveys: one before the workshop and the other after the workshop. Both questionnaires contain their basic knowledge and attitudes towards big data technology and a Professionalism Mini-Evaluation Exercise (P-MEX) instrument. The P-MEX is developed from the mini-Clinical Examination Exercise format by Cruess *et al* in 2006 to evaluate professionalism in clinical training.²² It consists of 24 items representing four skill categories: doctor–patient relationship skills, reflective skills, time management and interprofessional relationship skills.^{23 24} And the reliability and validity of P-MEX have been confirmed in both Eastern and Western cultural backgrounds.^{25–27} The attitude scale is a self-created scale focused on measuring participants' pedagogic evaluation, acceptance and expectation of the big data platforms. It consisted of eight questions: (1) Big data platform could assist future medical education, (2) Big data platform could assist future medical research, (3) Big data platform could assist future clinical practice, (4) I am willing to learn how to use big data platform, (5) I am willing to use big data platform in the future, (6) I am willing to recommend big data platform to my colleagues, (7) Big data platform could benefit my career, and (8) Big data platform could benefit all medical careers. For each question, students chose from 'totally agree', 'agree', 'disagree', and 'totally disagree'. For the applicability of conclusions, 'totally agree' and 'agree' were regarded as 'positive attitudes', and 'disagree' and 'totally disagree' were considered as 'negative attitudes'. In addition, the first survey also contained students' baseline information,

and the second survey contained a satisfaction questionnaire. Meanwhile, the browsing histories of participants in Section 3 were also recorded and analysed to reflect students' interests.

NUWA platform

The NUWA platform is the first nationwide Gynecologic Oncology data-sharing platform launched by the National Clinical Research Center for Gynecologic Oncology in August 2019. This platform integrated inpatient/outpatient clinical data, genomic data and follow-up data to develop a patient-level longitudinal clinicogenomic database. Information was deidentified and extracted from electronic medical records. A rigorous data quality check was performed to ensure the accuracy of the data entries. Since its foundation in 2019, 17 first-class hospitals from different provinces or cities in China have participated in the NUWA platform until August 2021.

Statistical analysis

Descriptive statistics were presented by counts and percentages to describe the demographic information. The χ^2 test was used to compare the changes in knowledge and understanding of big data and professionalism before and after the workshop. To acquire more practical results, the categories 'not at all important' and 'not important' were combined for the analysis, as well as 'important' and 'very important'. $P < 0.05$ were considered statistically significant. The data were analysed using R V.4.03.

Patient and public involvement

No patients or members of the public were involved in this study.

RESULTS

Characteristics of students

A total of 274 students participated in this workshop and completed two surveys. All of them were included in the final analysis. Participants were aged between 22 and 28, with 148 (54.0%) preclinical students and 126 (46.0%) clinical students. Among them, 130 (47.4%) were males and 144 (52.6%) were females (table 1).

The majority of participants (207, 75.5%) knew of at least one big data platform in China or the world. Over two-thirds of them (183, 66.8%) also acknowledged its application. However, only 17.2% (47) of them had been involved in any project related to medical big data (table 1).

Knowledge of big data platforms

Before the workshop, approximately a quarter of the students (74, 27%) knew the detailed contents of at least one medical big data platform, while nearly 64% (174) knew the potential application of medical big data platforms. After attending the lessons, almost all students could understand the content (253, 92%) and

Table 1 Baseline characteristics for participants

Characteristics	Number of participants, n (%)
Age, years	
22	27 (9.9%)
23	16 (5.8%)
24	67 (24.5%)
25	66 (24.1%)
26	50 (18.2%)
27	28 (10.2%)
28	20 (7.3%)
Gender	
Male	130 (47.4%)
Female	144 (52.6%)
Study stage	
Preclinical	148 (54.0%)
Clinical	126 (46.0%)
Acknowledgement of any kind of big data platform	
Yes	207 (75.5%)
No	67 (24.5%)
Know the applications of big data technology	
Yes	183 (66.8%)
No	91 (33.2%)
Involved in any big data-related projects	
Yes	47 (17.2%)
No	227 (82.8%)
	274 (100%)

the potential application (253, 92%) of medical big data (figure 1 and online supplemental table S1).

Regardless of the survey completed (precourse or postcourse), the majority of students believed that big data technology is practical in medical education, clinical practice and scientific research (85%, 77%, 82% before the workshop; 99%, 87%, 95% after the workshop, respectively) (figure 1 and online supplemental table S1).

Students' attitudes towards big data platforms

Even before the workshop, most students hold a positive attitude on the potential of the big data platforms in promoting medical education (237, 86%), medical research (256, 93%), and clinical practices (247, 90%). They were also willing to learn about and use the big data platforms (250, 91%, and 218, 80%, respectively). Of them, 74% (202) were enthusiastic about introducing big data platforms to their colleagues. Interestingly, most students were convinced that the big data platforms could benefit their careers (248, 91%), but they were not sure if it would yield the same effect on the others (128, 47%) (figure 2 and online supplemental table S2).

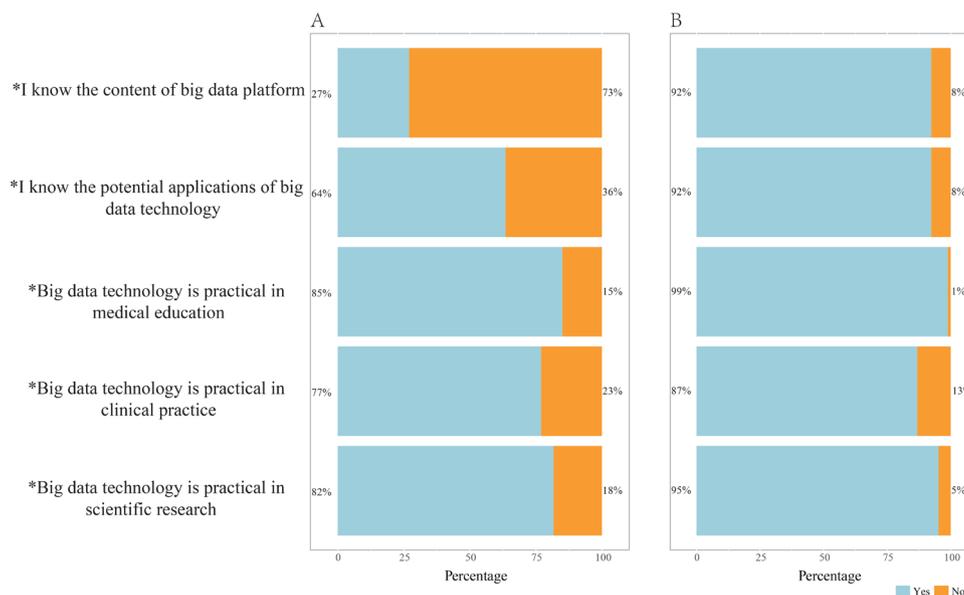


Figure 1 Basic knowledge for big data platform (A) before and (B) after the workshop. * means that there is a significant difference before and after the workshop.

When the workshop was completed, almost all students had positive attitudes towards the big data platforms (figure 2 and online supplemental table S1). However, there were still 12% (34) and 18% (48) of students who were not sure if the big data platform could benefit their and others' medical careers, respectively.

Professionalism

Generally, positive attitudes towards all the professionalism items were demonstrated, with more than three-quarters of the students agreeing that all professionalism attributes were 'important' or 'very important' before the workshop. The three items that most students thought were 'not at all important' or 'not important' were

maintaining patient confidentiality (66, 24% of students chose 'not important' or 'not at all important'), maintaining appropriate appearance (60, 22% students chose 'not important' or 'not at all important') and respecting rules and procedures of the system (55, 20% students chose 'not important' or 'not at all important') (figure 3A and online supplemental table S3).

After the lectures, students exhibited more positive attitudes on most professionalism items ($p < 0.05$). The most significant improvements occurred for 'Maintaining patient confidentiality' (from 76% to 95%), 'Listen actively to patient' (from 89% to 100%), and 'Accepting feedback' (from 89% to 98%) (figure 3B and online supplemental table S3).

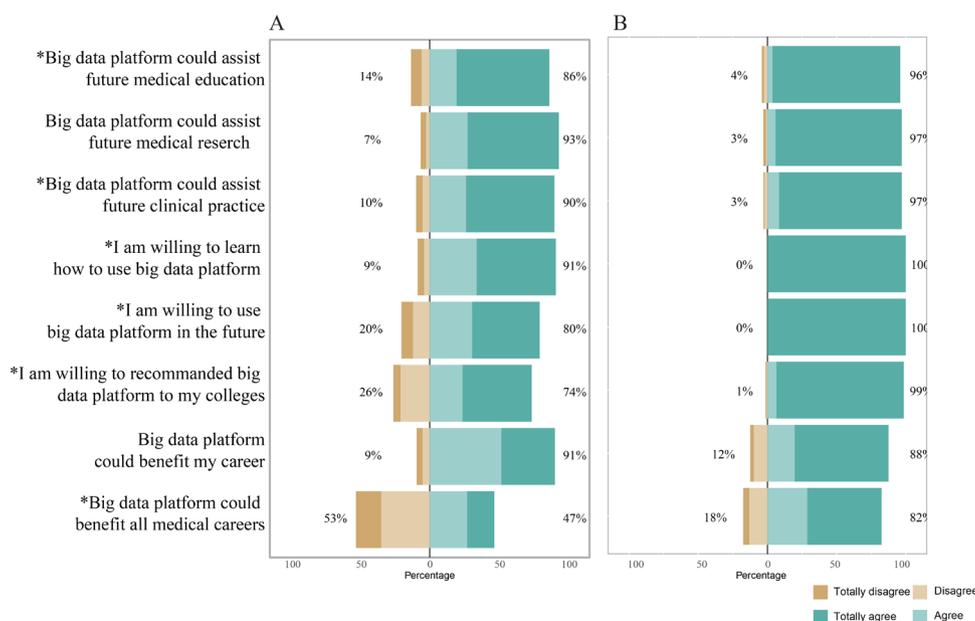


Figure 2 Students' attitudes towards big data platform (A) before and (B) after the workshop. * means that there is a significant difference before and after the workshop.

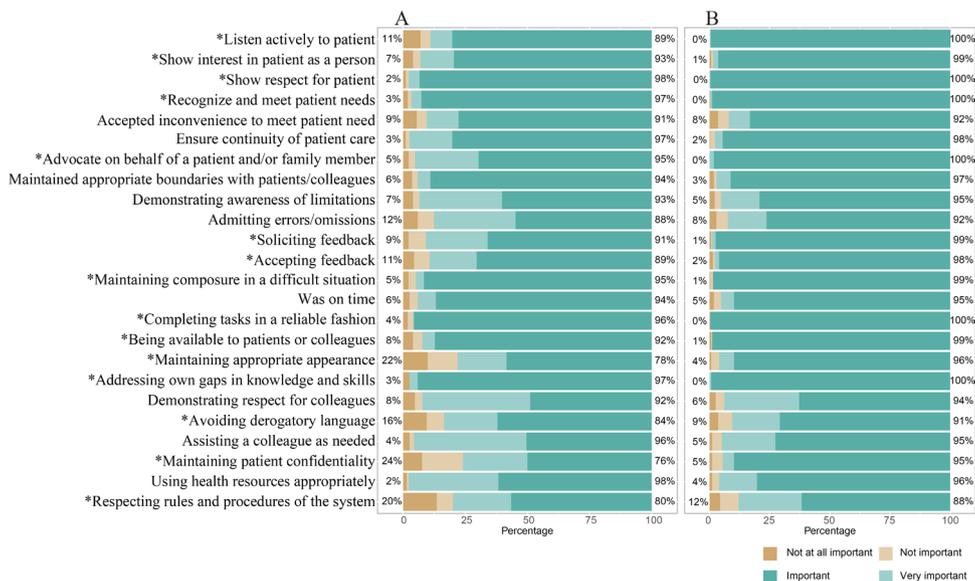


Figure 3 The professionalism for students (A) before and (B) after the workshop. * means that there is a significant difference before and after the workshop.

Interest in medical data

In the free exploration section, most students (253, 92.3%) viewed the patients' hospitalisation logs. A total of 76.3% (209) of students were interested in the patients' history of illness. Meanwhile, many students were interested in medicine usages (56.2%), surgery reports (52.9%) and diseases of rare pathologies (58.6%). Only approximately one-third of students viewed image diagnosis (37.6%) and follow-up records (32.5%) (table 2).

Satisfactory survey

On completing the survey, 95.6% (262) of participants were 'satisfied' or 'extremely satisfied' with this workshop, and only 7 out of 274 students were not at all satisfied. However, we failed to obtain feedback from them in the next 3 months. Most students thought the workshop was informative (249, 90.9%) and understandable (255, 93.1%). The majority of students were also willing to recommend this seminar to other students (257, 93.8%) and to participate in similar classes in the future (254, 92.7%). Regarding the duration of this workshop, only 7 (2.6%) students thought that 2 hours was too long (table 3).

DISCUSSION

Our study demonstrated that Chinese medical students have little knowledge of and positive attitudes towards big data technology. They also yield expertise in professionalism. Furthermore, workshops based on big data platforms could further strengthen their digital competencies and improve doctor-patient communication capabilities, which would lead to better fitness during the expansion of medical big data.

In this workshop, the basic knowledge of big data platforms in China was measured. Although a large fraction of students knew about the big data platforms and the

utility, only a few of them could apprehend their composition or how to use them. This situation may be caused by the recent rapid development of big data technology in China and comparatively lagging relevant education.^{28 29} In addition, ethical challenges that hinder medical and

Table 2 Browser records in the free-exploration section

Content	Number of participants, n (%)
History of Illness	
Yes	209 (76.3%)
No	65 (23.7%)
Hospitalisation logs	
Yes	253 (92.3%)
No	21 (7.7%)
Medicine usage	
Yes	154 (56.2%)
No	120 (43.8%)
Surgery record	
Yes	145 (52.9%)
No	129 (47.1%)
Image diagnosis	
Yes	103 (37.6%)
No	171 (62.4%)
Follow-up records	
Yes	89 (32.5%)
No	185 (67.5%)
Rare pathologies	
Yes	160 (58.4%)
No	114 (41.6%)
Total	274 (100%)

**Table 3** Participants 'answers to the workshop satisfaction survey

	Not at all, N (%)	No, N (%)	Yes, N (%)	Yes, extremely, N (%)	Mean	SD
Overall, are you satisfied with this course	7 (2.6%)	5 (1.8%)	57 (20.8%)	205 (74.8%)	3.68	0.640
Did you think the course are informative?	10 (3.6%)	15 (5.5%)	101 (36.9%)	148 (54.0%)	3.41	0.757
Did you think the duration of this courses is too long	121 (44.2%)	118 (43.1%)	28 (10.2%)	7 (2.6%)	2.07	0.954
Was the course understandable for you	11 (4.0%)	8 (2.9%)	121 (44.2%)	134 (48.9%)	3.38	0.733
Would you recommend these courses to other students?	6 (2.2%)	11 (4.0%)	144 (52.6%)	113 (41.2%)	3.33	0.659
Are you willing to take part in similar courses in the future?	6 (2.2%)	14 (5.1%)	35 (12.8%)	219 (79.9%)	3.70	0.666

public health data sharing may have also exacerbated the situation.³⁰ Therefore, aside from conducting big data-related workshops, promoting medical and public health data sharing policies and evolving relevant legal and ethical implications are also of great importance.

Students' enthusiasm towards medical big data was also taken into consideration. As expected and consistent with previous reports,²⁵ the majority of students exhibited positive attitudes towards the big data platforms and were willing to acquire further proficiency. They believed that big data would play a vital role in future medical education, clinical practice and scientific research, which are the main tasks for all Chinese doctors. However, not all of them believed that big data could benefit all medical careers. The popularity of information technology in China recently may contribute to the big data-friendly intention of medical students.³¹ Meanwhile, their limited understanding of related fields may hamper the belief that it could be used productively.^{32–34} In the meantime, we were delighted to see that almost all students recognised the significance of big data after our workshop. We thus believe that proper education may be an efficient way to diminish misunderstandings and achieve full potential in big data platforms.

Professionalism was related to the development of big data in our study for the first time in China. Considering that big data can reshape medical activities in all aspects, including doctors' attitudes towards their colleagues and patients,³⁵ a lecture about 'professionalism in the age of big data' was presented in the current workshop. Before the seminar, students demonstrated sufficient professionalism, similar to the findings of previous reports, with high scores on the majority of these items. Nevertheless, it is worth noting that nearly 1/4 of the participants did not pay enough attention to maintaining patient confidentiality. Protecting patients' privacy is an essential embodiment of medical ethics and humanities.³⁶ Participants mostly answered these questions from the perspective of big data users before our workshop, ignoring that those data represented thousands of actual patients. After we emphasised the importance of data privacy in the workshop, students realised that respect for patients is the foundation for improving their medical professionalism. Meanwhile, to enhance patient-data privacy protection,

the privacy information, such as ID number, was privatised and converted into an alternative ID number using a hashing algorithm before being uploaded to the NUWA platform. Therefore, the personal information of all included patients in the NUWA platform is confidential and unreachable to all users. Several important professionalism levels were also significantly increased in many other elements after the workshop, indicating that this workshop could be a preliminary attempt to promote professionalism when the prominence of digital data has changed the way we communicate and when doctors have to spend more time with electronic records than with patients. These changes our workshop brought deserve more attention in China since Chinese doctors are well known to be overburdened.^{37 38} These improvements could also help increase the reliability of medical records and produce convincing and effective medical information.

Another interesting fact in the results is that approximately 60% of students noticed rare diseases in the free-exploration section, which is hardly involved in routine medical classes.^{39 40} We believe this is another strength of big data-based medical education. In traditional medical classes, it is arduous for teachers to grant detailed depictions for every type of rare disease. As a result, students may not have easy access to these exceptional cases and therefore are often not able to diagnose rare diseases when reviewing patients' medical records. The big data platform makes it possible for every user to conveniently browse through cases with rare pathologies, which would benefit patients as well as reduce misdiagnoses.

Our workshop had some limitations. The most important one is that the NUWA platform is still under development, and the omics data are not currently included. Therefore, another investigation should be conducted when the construction of NUWA has been completed. Meanwhile, we did not calculate the sample size before the conduction of this study, which may lead to potential bias. And the limited sample size may be another reason that restricts the popularisation of our conclusion. Furthermore, narrow geographical distributions of study participants interfered with the generalisation of our results to other populations. Meanwhile, there are concerns that students who volunteered to

participate in the workshop may be more enthusiastic about big data technology than those who did not. We thus included all fifth-grade (preclinical) and sixth-grade (clinical) students of 8-year undergraduate education in Tongji Medical School to make the study sample more representative. As for the measurement of attitudes and professionalism, a qualitative approach would have been more appropriate and should be considered in the future. Meanwhile, this workshop is too short to produce fundamental improvements in students' attitudes and professionalism. In the future, more long-term studies are wanted to draw a clear conclusion.

CONCLUSION

This study depicted Chinese students' knowledge of medical big data for the first time and the NUWA platform-based workshop had the potential to improve their understanding of big data and enhance professionalism.

Contributors Q-LG, JL and XJ designed the study and survey. Q-LG, JL, XJ, ML, ZP, YH and SZ conducted the workshop. PJ, HL, JC, XL, YY and SZ analysed and interpreted the data. YZ and GM performed interpretation of data and discussion of findings. Q-LG conceptualised and designed the study, supervised the project, analysed and interpreted the data, and wrote the paper. Q-LG is the guarantor and accepts full responsibility for the overall content. All authors approved the final version of the manuscript and agreed to the submission of this manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The data collection and analysis plan were acknowledged and agreed by all participants and the study has been approved by the Research Ethics Commission of Tongji Hospital of Huazhong University of Science and Technology (2020-S201). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. All data relevant to the study are included in the article or uploaded as supplementary information.

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Supplemental tables

Table S1, basic knowledge for big data platform before and after the workshop.

Items	Before Workshop		After Workshop		<i>P</i>
	YES, n	NO, n	YES, n	NO, n	
I know the content of big data platform	74	200	253	21	<0.0001
I know the potential applications of big data technology	174	100	253	21	<0.0001
Big data technology is practical in medical education	233	41	271	3	<0.0001
Big data technology is practical in clinical practice	211	63	238	36	0.0039
Big data technology is practical in scientific research	224	50	261	13	<0.0001

Table S2, students' attitude towards big data platform before and after the workshop.

Items	Before Workshop						After Workshop						<i>P</i>
	Totally disagree, n	Disagree, n	Agree, n	Totally agree, n	Mean	SD	Totally disagree, n	Disagree, n	Agree, n	Totally agree, n	Mean	SD	
Big data platform could assist future medical education	21	16	53	184	3.50	0.910	4	7	10	253	3.87	0.504	0.0002
Big data platform could assist future scientific research	11	7	75	181	3.55	0.735	5	3	16	250	3.86	0.499	0.0705
Big data platform could assist future clinical practice	13	14	72	175	3.49	0.799	2	6	23	243	3.85	0.464	0.0017
I am willing to learn how to use big data platform	13	11	93	157	3.43	0.783	0	0	0	274	4	0	<0.0001

I am willing to use big data platform in the future	23	33	84	134	3.20	0.953	0	0	0	274	4	0	<0.0001
I am willing to recommended big data platform to my colleagues	14	58	65	137	3.19	0.941	2	2	18	252	3.90	0.388	<0.0001
Big data platform could benefit my career	12	14	142	106	3.25	0.744	7	27	54	186	3.53	0.776	0.3382
Big data platform could benefit all medical careers	50	96	74	54	2.48	1.006	12	36	79	147	3.32	0.863	<0.0001

SD, Standard Deviation.

Table S3, the professionalism for students before and after the workshop.

Items	Before workshop				After workshop				P
	Not at all important, n	Not important, n	Important, n	Very important, n	Not at all important, n	Not important, n	Important, n	Very important, n	
Doctor-patient relationship skills									
Listen actively to patient	19	11	24	220	0	0	1	273	<0.0001
Show interest in patient as a person	11	8	37	218	2	2	6	264	0.0029
Show respect for patient	3	3	12	256	0	0	1	273	0.0401
Recognize and meet patient needs	5	4	11	254	1	0	2	271	0.0255
Accepted inconvenience to meet patient need	15	11	35	213	10	12	24	228	0.6503
Ensure continuity of patient care	3	4	47	220	1	5	9	259	1

Advocate on behalf of a patient and/or family member	6	7	70	191	0	0	5	269	0.0008
Maintained appropriate boundaries with patients/colleagues	10	6	14	244	5	3	16	250	0.1440
Reflective skills									
Demonstrating awareness of limitations	11	7	91	165	6	7	44	217	0.4595
Admitting errors/omissions	16	18	90	150	8	13	44	209	0.0880
Soliciting feedback	6	19	68	181	2	1	4	267	<0.0001
Accepting feedback	12	17	52	193	4	2	5	263	0.0001
Maintaining composure in a difficult situation	6	8	9	251	1	3	0	270	0.0310
Time management									
Was on time	7	9	20	238	5	8	15	246	0.7027
Completing tasks in a reliable fashion	5	6	1	262	1	0	0	273	0.0086
Being available to patients or colleagues	11	10	14	239	2	1	0	271	0.0004
Interprofessional relationship skills									
Maintaining appropriate appearance	27	33	54	160	2	9	17	246	<0.0001
Addressing own gaps in knowledge and skills	7	0	9	258	0	0	2	272	0.0225
Demonstrating respect for colleagues	13	8	119	134	7	10	85	172	0.6139
Avoiding derogatory language	26	19	59	170	10	16	54	194	0.0220
Assisting a colleague as needed	7	5	124	138	3	11	61	199	0.8407

Maintaining patient confidentiality	21	45	71	137	3	12	13	246	<i><0.000</i> <i>1</i>
Using health resources appropriately	4	2	99	169	3	8	43	220	<i>0.3244</i>
Respecting rules and procedures of the system	37	18	64	155	12	21	72	169	<i>0.0146</i>