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 towards 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 diagnosis6,8 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.11–15

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.\textsuperscript{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.\textsuperscript{18} And Cain et al summarised professionalism as a series of attributes, such as altruism, respect, honesty and so on.\textsuperscript{19} Some studies have shown that digital medical education based on big data plays a positive effect in promoting professionalism.\textsuperscript{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 lasted for 2 hours and consisted of three main 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.\textsuperscript{22} It consists of 24 items representing four skill categories: doctor–patient relationship skills, reflective skills, time management and interprofessional relationship skills.\textsuperscript{23,24} And the reliability and validity of P-MEX have been confirmed in both Eastern and Western cultural backgrounds.\textsuperscript{25-27} The attitude scale is a self-created scale focused on measuring participants’ pedagogical 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 \( \chi^2 \) 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 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).

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**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%)                  |
| Total                                          | 274 (100%)                   |
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 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.

**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.
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. 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%)                |
Meanwhile, to enhance patient-foundation for improving their medical professionalism.

shop, students realised that respect for patients is the emphasised the importance of data privacy in the work-
data represented thousands of actual patients. After we big data users before our workshop, ignoring that those mostly answered these questions from the perspective of China recently may contribute to the big data-
careers. The popularity of information technology in the main tasks for all Chinese doctors. However, not all with previous reports, the majority of students exhibited understanding of related fields may hamper the belief 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 the 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. 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-
section, which is hardly involved in routine medical classes. 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

| 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 |
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 O-LG, JL and XJ designed the study and survey. O-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. O-LG conceptualised and designed the study, supervised the project, analysed and interpreted the data, and wrote the paper. O-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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Patient consent for publication Not applicable.

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