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Crossing Between Clinical Work and Scholarly Publishing: Early-Career Neurosurgeons as Clinician-Researchers

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Abstract

Medical professionals who assume multiple roles as clinicians and researchers are commonly found in hospitals worldwide. Likewise, in many Chinese hospitals, particularly among early-career medical professionals with M.D. and Ph.D. degrees, active engagement in both clinical practice and scientific research is expected. In the current ethnographic study, the cultural-historical activity theory is used to explore how three early-career neurosurgeons at a tier-one northern-Chinese hospital conduct and write research for publishing in SCI-indexed journals in addition to handling their heavy clinical workload. Drawing on multiple sources of qualitative data, including semi-structured interviews, two-week naturalistic observations, field notes, photographs, and daily activity logs with three neurosurgeons, the study findings highlight Chinese neurosurgeons conduct and write up their research using patient data and collaborating with laboratories while seeking academic language editing and peer feedback. Ethical considerations of clinician-researchers' scholarly publishing process, implications for researching medical professionals' boundary crossings, and future research directions are also discussed.
Keywords: scholarly publishing; scientific writing; clinician-researchers; early-career researchers; second-language writers

INTRODUCTION

"Wearing Multiple Hats": Scholarly Publishing and Medical Professionals

According to the annual statistical data of Chinese science and technology papers, China has consistently held second place in terms of contributions to "international journals" (i.e., *Thomson Reuter*'s Science Citation Index, or SCI) in the past two decades (ISTIC, 2021). When considering research articles and systematic reviews, which are commonly analyzed in scientometrics studies (Bornmann & Bauer, 2015), however, since 2018, a different trend has emerged showing that China has surpassed the U.S. and emerged as the leading global producer of SCI-indexed papers. Significantly, China has experienced a remarkable increase in publishing SCI-indexed papers, rising from 137,000 in 2010 to 482,000 in 2019, marking a growth rate of 252%. In contrast, the growth in publication outputs from the U.S. has been relatively slower, increasing from 304,000 in 2010 to 400,000 in 2019, indicating a growth rate of 31%. Chinese researchers have also edged out their American counterparts in the number of most cited papers, a key measure of research impact (NISTEP, 2022). Although it is estimated that only a fraction of the 70,000-odd Chinese-authored papers in the *Medline* database in 2021 were published by medical professionals affiliated with Chinese hospitals, notably, staff in the three most productive hospitals in China published 1,852, 1,332, and 1,132 SCI-indexed papers (ISTIC, 2021).

Medical professionals in hospitals globally often assume the dual roles of clinician and researcher, commonly referred to as clinician-researchers or clinician-scientists (Eisenberg, 2010), particularly within research-oriented medical centers or hospitals (Li, 2014a). However, the Anglo-American medical landscape has witnessed a steady decline in the number of physicians-clinicians (e.g., general surgeons, neurosurgeons, obstetricians, and pediatric surgeons) and non-physician clinicians (e.g., nurses, dentists, and allied health professionals)

engaging in scholarly publishing over the last decades, leading to concerns about the dwindling presence of these medical professionals, often described as a "rare breed under threat" (Lemoine, 2008), or an "endangered species" (Sobel, 2002). Multiple factors have contributed to this decline, including challenges related to research funding, medical training, and research mentorship (see Kluijtmans et al., 2017; Li, 2014a); the shortage of these medical professionals has led to increased interest in medical education programs and scientific writing societies (see Kluijtmans et al., 2017; Monrouxe, 2010; Lillis & Curry, 2010). Remarkably, several exploratory qualitative studies conducted with physician and non-physician clinicians have revealed that the increasing demands of patient care/treatment and other service responsibilities leave little time for scientific research among Asian and Anglo-American medical professionals (Li, 2014a; Yanos & Ziedonis, 2006).

Clinician-researchers in Anglo-American medical centers are normally expected to allocate around half of their working time for conducting research, while physician-clinician-researchers are expected to spend even more time on research (Li, 2014a). Both physicians and non-physicians working at Chinese tier-one hospitals are primarily considered full-time clinicians without being given official time for research (Li, 2014a), although they are still expected to publish in top-tier SCI-indexed journals using English as their second language (L2) (Huang et al., 2010, Ren & Hu, 2023). Therefore, compared with their counterparts in other parts of the world, the lack of time for research coupled with the need to publish their research in English has tended to burden Chinese clinician-researchers. One survey study conducted at several northern Chinese hospitals (Hu et al., 2011) and one interview study conducted at an eastern Chinese hospital (Li, 2014a) revealed that surgeons as clinician-researchers in China lack time for research because their clinician duties occupy too much of their time. Another study (Li, 2014b) with the same participants conducted in the same year also noted how Chinese clinician-researchers face pressure and challenges with publishing SCI-indexed papers (in their L2) compared with the "relatively easy" (p. 118) writing and publishing process they experienced when submitting to domestic Chinese journals because of their limited training in writing in English at Chinese schools and universities in the 2000s.

Regarding the nature of medical research, those with clinical training primarily engage in clinical research (i.e., patient-oriented research), which normally includes therapy studies, prognostic studies, diagnostic studies, and single case and case series studies (e.g., Wang et al., 2021, Zhang et al., 2023). The clinical research process may involve the collection and use of clinically obtained data, which may include samples requiring laboratory testing or experiments (e.g., blood and tumor samples) as well as those that do not (e.g., patients' medical records, Computerized Tomography-CT, and Magnetic Resonance Imaging-MRI). Clinical data collection entails various processes such as building databases, aggregating large amounts of retrospective data, and collecting prospective data over prolonged periods, often involving multiple stakeholders (Li, 2014a). Although some major research-orientated hospitals in China have automated database systems to facilitate patient data storage and retrieval, individual physician clinician-researchers sometimes have to collect their own clinical data for scholarly publishing (Charlesworth et al., 2009). Some physician clinician-researchers are also involved in laboratory-based basic research (e.g., animal studies, cell studies, and genetic studies), which may be conducted by collaborating with medical centers or research-based medical universities (Chai et al., 2020; Zhang et al., 2021). Unfortunately, relatively little is known about physician-clinicians conducting either or both types of medical research apart from their having a heavy clinical workload, i.e., few studies, if any, have reported the methods they employ to collect data and the

way they write scientific papers. Therefore, the aim of the present study is to understand how early-career Chinese neurosurgeons as clinician-researchers succeed in conducting and writing up their scientific research in English while conducting clinical practice.

Cultural-Historical Activity Theory and the Current Study

The cultural-historical activity theory evolved out of Vygotsky's mediation model (1978) and Leontiev's (1978) object-oriented activity unit of analysis, which comprises six components: subject, tool, object, rules, community, and division of labor (Engeström, 2000). This theory highlights the socio-historical dimensions of these components within an activity system and focuses on network relations between multiple activity systems. Early-career Chinese neurosurgeons, in this context, engage in two main activity systems - a clinical system focused on patient care, and a scholarly publishing system dedicated to medical advancements. The historical and socio-economic contexts play a significant role in shaping these systems as exemplified by the evolving situation of Chinese medical professionals. On the one hand, they face mounting pressure in clinical practice due to shifting doctor-patient dynamics (Li, 2014a). On the other hand, the need for degree conferment, grant funding, and academic promotion, which are connected to rigorous assessment schemes, can create a potential conflict of interest concerning how early-career neurosurgeons allot their time.

Chinese neurosurgeons' clinical and research activities have overlapping objectives and share tools at the macroscopic level. The clinical activities involve treating patients while research involves publishing methods/findings regarding new treatments or basic research, while tools, such as medical records, patients' MRIs, and basic information, may be used both to treat patients and as research data. However, successful participation in both areas requires the presence of "horizontal expertise" - the ability to traverse the diverse contexts of these systems (i.e., boundary crossing between activities) and combine resources for hybrid solutions (Bhatti et al., 2010; Li, 2014a). Some hybrid solutions that enable Chinese neurosurgeons to cross boundaries may include using clinically obtained ideas and data for research design, proposing and sharing research ideas with lab-based research teams, applying time management strategies for alleviating time pressure, and inviting third parties from the clinical environment (i.e., feedback from peers, comments from native English neurosurgical professors) to improve scientific writing in English. However, as I describe above, the activity system of these early-career Chinese neurosurgeons and how it can impact the doctor-patient-research dynamic need further exploration.

Overall, leveraging cultural-historical activity theory, the current qualitative study using ethnographic methods aims to understand how early-career Chinese neurosurgeons, working as clinician-researchers, navigate the intersection of delivering patient care and engaging in scholarly publishing in SCI-indexed journals within an academic hospital setting in China. Accordingly, this study is guided by the following research question: "How do early-career Chinese neurosurgeons conduct and write scientific research in English apart from their daily clinical practice?"

METHOD

Research Contexts and Participants

The current study was conducted at a neurosurgery department in a tier-one teaching hospital[1] affiliated with a public medical university in northern China. The neurosurgery

[1] A tier-one hospital is a Level-3-Grade-A hospital (*Sanji Jiadeng Yiyuan*), which is regarded as the highest-grade hospital in China. Many Level-3-Grade-A hospitals in China are affiliated with medical schools or universities, such

department specializes in various aspects of clinical and lab-based neurosurgical diseases, such as brain and spinal tumors, brain and spine injuries and pain, strokes, trigeminal neuralgia, Parkinson's disease, and epilepsy. As a teaching hospital, the neurosurgical department also hosts domestic and international undergraduate medical students pursuing bachelor's (U.S. equivalency M.D.) degrees in clinical medicine[1], as well as postgraduate student neurosurgeons[2] pursuing master's and Ph.D. degrees in surgery (neurosurgery). During the fieldwork of this study, which occurred from July to August 2023, the department had a staff of approximately 50 full-time neurosurgeons[3], 200 degree-pursuing student neurosurgeons, 300 nurses, and visiting neurosurgeons from other domestic and international medical centers and hospitals.

The department's clinical workload is substantial; in 2022, nearly 190,000 patients sought treatment at the outpatient clinic of the department, and about 20,000 operations are performed each year. Further, competition between student neurosurgeons and full-time neurosurgeons in the department is fierce in terms of securing scholarships and funding, academic promotion, and recognition at national and local levels. One's status is mainly based on one's clinical service and publication output, particularly regarding papers published in SCI-indexed journals. According to an attending neurosurgeon[4] who worked in the department, the number of SCI-journal-authored papers and their impact factors largely determine both a neurosurgeon's and a department's status. In the department, the affiliated degree-pursuing neurosurgeons and full-time neurosurgeons collaboratively produced about 200 SCI-indexed papers as first or co-first authors in 2021. Similar to other Chinese hospitals, this hospital implemented a publication policy for degree-pursuing neurosurgeons and full-time neurosurgeons. Failure to publish a minimum number of SCI-indexed papers annually could lead to exclusion from opportunities for scholarships, awards, and academic promotion.

To understand how early-career neurosurgeons conduct and write scientific research despite their heavy clinical workload, I invited three neurosurgeons in this department who

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as the First Affiliate Hospital of Peking University in Beijing, the West China Hospital of Sichuan University in Chengdu, and the Zhongshan Hospital of Fudan University in Shanghai. In 2021, China had 1,441 Level 3-Grade A hospitals according to the Ministry of Health of China (2022).

[1] The five-year Bachelor of Medicine degree obtained by medical students in China is equivalent to the American Doctor of Medicine (M.D.) degree which is the first professional degree in medicine.

[2] Chinese postgraduate students who have obtained their Bachelor of Medicine degree (U.S. equivalency M.D.) in clinical medicine from medical schools are still considered physicians in training. Residency is the period of training Resident Physicians (*Zhuyuan Yishi*) undertake to become a particular type of physician, such as a general surgeon, cardiac surgeon, and neurosurgeon. Chinese postgraduate students, as Resident Physicians, are normally required to provide in- and out-patient services during their postgraduate training, such as consulting and writing patients' medical records, managing in- and out-patients, attending ward observations, and observing or performing operations under the supervision of full-time neurosurgeons with faculty titles such as Associate Professor or Full Professor of the medical university.

[3] Full-time neurosurgeons who are conducting research usually hold faculty titles such as Lecturer (U.S. equivalency: Assistant Professor), Associate Professor and Full Professor at medical schools or universities in China. Full-time senior neurosurgeons who are granted the faculty title of Associate Professor or Full Professor normally can supervise master's and Ph.D. degree student neurosurgeons who are early-career resident physicians.

[4] Attending Physician (*Zhuzhi Yishi*) in China refers to a physician who has finished postgraduate training (i.e., residency) as a resident physician. Attending Physicians (and Resident Physicians) are early-career physicians, who can be promoted to senior physicians (i.e., Associate Chief Physicians and Chief Physicians) after passing the clinical performance review. Those Attending Physicians who also conduct scientific research can be granted the faculty title of Lecturer (U.S. equivalency: Assistant Professor) of their university and can also be promoted to Associate Professor or Full Professor after passing an academic performance review. This is the dual-title system (clinician/scientist) at Chinese medical universities.

willingly agreed to participate in the study by signing the informed consent forms. Among these neurosurgeons, N1 is a master's student currently studying and working as a resident physician in the department. N2 is a Ph.D. student who graduated with a master's degree in neurosurgery from the department in late 2020 and is studying and working as a resident physician in the department. N3 is an attending physician who obtained both master's and Ph.D. degrees in neurosurgery from the department. Like most neurosurgery majors in Chinese medical schools, most students and physicians majoring in neurosurgery are male. All neurosurgeons had received their bachelor's (U.S. equivalency M.D.) degrees while training in clinical medicine in other Chinese medical schools between 2010-2020 and currently are required to provide clinical care to patients and publish their research. Three neurosurgeons completed a short survey collecting detailed information about their clinical and research background before the interviews (see Table 1).

TABLE 1. Participant's information

Name	Research Area(s)	Position(s)	Degree(s)	Age	SCI Publications in English (n/%)
N1	Major Area: Neuro-Oncology and Spinal Neurosurgery Clinical Research: Brian/Spinal Tumors (e.g., glioma, ependymoma), and Spinal Cord Injury Lab-Based Research: Molecular Pathological Analysis of Brian and Spinal Tumors	Resident Physician and Master's Student	Bachelor of Medicine (U.S. equivalency M.D.) in Clinical Medicine Master of Surgery in Neurosurgery (In Progress)	Late 20s	Original Research: 6 / 85.71% Meta-Analysis: 1 / 14.29%
N2	Major Area: Cerebrovascular Neurosurgery Clinical Research: Ischemic Stroke, Hemorrhagic Stroke, and Moyamoya Disease Lab-Based Research: Stroke Mouse Modeling	Resident Physician and Ph.D. Student	Bachelor of Medicine (U.S. equivalency M.D.) in Clinical Medicine Master of Surgery in Neurosurgery Doctor of Philosophy (Ph.D.) in Neurosurgery (In Progress)	Late 20s	Original Research: 10 / 90.00% Case Report: 1 / 10.00%
N3	Major Area: Functional Neurosurgery Clinical Research: Epilepsy, Parkinson's Disease, and Trigeminal Neuralgia Lab-Based Research: Trigeminal Neuralgia Mouse Modeling	Attending Physician and Lecturer (Assistant Professor)	Bachelor of Medicine (U.S. equivalency M.D.) in Clinical Medicine Master of Surgery in Neurosurgery Doctor of Philosophy (Ph.D.) in Neurosurgery	Early 30s	Original Research: 13 / 81.25% Case Report: 2 / 12.50% Systematic Review: 1 / 6.25%

Research Instruments

Semi-Structured Interviews

In late July 2023, I scheduled the in-person semi-structured interviews with the three neurosurgeons focusing on understanding their past experiences (i.e., their clinical and scholarly publishing activities) and perceptions of their boundary crossings between clinical practice and scholarly publishing. The interviews were conducted in Mandarin Chinese at the office of the deputy head of the department, and each interview lasted approximately 90 minutes. Throughout the interviews, I encouraged the three neurosurgeons to reflect on and share their past clinical practice and scholarly publishing experience.

Naturalistic Observations, Field Notes, and Photographs

From 31 July 2023 to 13 August 2023, I visited the neurosurgery department every two days to conduct a series of naturalistic observations at the following sites: the outpatient rooms where the three neurosurgeons consult with patients and write medical records for the out-patients with or without the supervision of senior neurosurgeons, the inpatient rooms where they manage the inpatients, two public offices[1] open for all neurosurgeons and nurses affiliated with the department, the private office[2] of the deputy head of the department, the laboratories located in and near the hospital where the neurosurgeons conduct lab-based studies, and the conference rooms in the department where they attend the daily report sessions. I also took field notes and photographs during my observation at multiple locations with the permission of the three neurosurgeons and the deputy head of the department. I shared the selected photographs intended for inclusion in this research paper with the three neurosurgeons, seeking their permission, and requested them to use a photo editor to blur their faces and any sensitive information before returning the selected photographs to me.

Daily Activities Logs

The three neurosurgeons were also required to maintain daily activity logs from 31 July 2023 to 13 August 2023. I distributed the daily activities log sheets with detailed guidelines to the three neurosurgeons on 28 July to document their typical daily routines (e.g., clinical and research work) from Monday through to Sunday. The information that the three neurosurgeons provided on the sheets included the date, time, activity, and participants. For example, N3 documented one of his activities as "date: 1 August," "time: 08:40- 08:50 a.m.," "activity: getting the signature of an adolescent female patient's father to approve an operation for his daughter," "place: inpatient room," and "participant(s): myself, the patient's father, and another resident neurosurgeon." After collecting their two-week activity log sheets on 15 August 2023, I discussed with the three neurosurgeons about their daily activities and they reflected on their typical clinical and research schedules.

Data Analysis

The in-person interviews were audio-recorded with the permission of the three neurosurgeons. Following the interviews, I transcribed the recorded data, translated them into English, and returned the transcripts to the three neurosurgeons for their review and comments.

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[1] These two public offices with shared desks are where N1 and N2 as postgraduate resident physicians rest, study, write up their research, and communicate with other neurosurgeons and nurses. N1 and N2 sometimes write their research in public offices and sometimes in the dormitory provided by the hospital (four students per room). Attending neurosurgeons like N3 and senior neurosurgeons are not provided with a dormitory by the hospital.

[2] In this hospital, only senior neurosurgeons (i.e., Associate Chief Physicians or Chief Physicians) with faculty titles as Associate Professor or Full Professor who are currently providing administrative services for the department or hospital are provided with a private office.

Two neurosurgeons made modifications which were incorporated into the final version of the interview data. I then coded all interview data using NVivo 14, a qualitative data analysis software produced by Lumivero (https://lumivero.com/products/nvivo/), to reveal themes related to their clinical and research activities. The tentative coding scheme was also provided to a research assistant working on my project as a reference to independently code the transcripts using NVivo 14. Table 2 presents the final coding scheme with strong coding reliability (Cohen's Kappa) on each code.

TABLE 2. Coding scheme for the interviews with coding reliability in parentheses

Code	Description	Example
Collecting patient data for clinical research (κ = 0.92)	Neurosurgeons' collection of patient data as clinical data for writing clinical research	We are a reputable hospital so I don't need to worry about clinical research data collection and paper writing because we can easily collect our patients' data with the patient's permission for writing clinical research. (N1)
Collaborating with laboratories for basic research (κ = 0.91)	Neurosurgeons' collaboration with different research laboratories for conducting lab-based research	My research team is collaborating with a very strong neuro-oncology research lab so we bring our tumor samples collected from daily operations in our hospital to the lab for further investigation such as molecular pathological analysis. (N3)
Seizing snippets of time for writing and research design (κ = 0.93)	Neurosurgeons' time management for keeping time to design and write their research for publishing in SCI-indexed journals	I use every bit of small time like my rest time, meal time, and night time to think about my research, read some literature, and note down any small research ideas. (N2)
Seeking academic editing and peer feedback for improving English writing (κ = 0.91)	Neurosurgeons' improvement of written scientific English through academic editing or feedback from peer neurosurgeons	We are L2 writers and we have a lot of clinical and research work to do every day… I usually seek academic editing from other native English neurosurgeons and clinical professors in my research areas. (N1)

I, together with a research assistant, also coded the daily activity logs of the three neurosurgeons to triangulate the data. This process using NVivo 14 mainly involved differentiating daily activities into two primary categories: "clinical activities" (κ = 0.93) and "scholarly publishing activities" (κ = 0.94). For example, "outpatients' consultation," "inpatients' management," and "morning meetings" were categorized as "clinical activities," while activities like "writing literature reviews," "seeking peer feedback on the manuscript," "collecting clinical research data," and "laboratory research with mice" were classified as "scholarly publishing activities."

To ensure the trustworthiness of the data analysis in the current study, an earlier version of this research paper was drafted and shared with the three neurosurgeons for their feedback through online document sharing and written or voiced messaging on WeChat in early September 2023. Responses from all three neurosurgeons were incorporated into the present revised version.

FINDINGS

Collecting Patient Data for Clinical Research

The three neurosurgeons acknowledged the inherent challenge of conducting research alongside their "demanding clinical work and responsibilities," as noted by one participant. However, they believed they had demonstrated commendable performance in terms of

publishing SCI-indexed papers and as one observed, "consistently exceeded the requirement for SCI publications" during their residency period. These early-career neurosurgeons had effectively crossed the boundary between their clinical work and their publishing endeavors. The first hybrid solution they applied was to take advantage of the rich patient data from the large number of patients who sought treatment to conduct studies and write up their findings and publish them. As these neurosurgeons explained:

> We are a reputable hospital so I don't need to worry about clinical research data collection and paper writing because we can easily collect our patients' data with the patient's permission for writing clinical research. I am collecting a new set of data with N2 and I believe we can publish more clinical case studies. (N1)

> We have a good reputation so many patients from all over China come for consultations and operations in our department yearly. Thus, I usually build good connections with my patients and follow up on their postoperative status and quality of life. In doing so, my research team and I have rich clinical data for publishing SCI-indexed papers. (N2)

> I started to collect patient data when I was a master's student in this department in the 2010s. We found clinical problems and used our patient data with permission to understand the nature and treatment of different neurosurgical issues. (N3)

During the interviews, all neurosurgeons shared their positive experience of frequently collecting patient data within the hospital for writing and publishing SCI-indexed papers and observed that the many patients they care for constitute the very basis of their clinical research. Table 3 presents their activities related to collecting clinical research data, and Figure 1, which contains two photographs, shows that the three neurosurgeons built their clinical research database in the inpatient public offices.

TABLE 3. Neurosurgeons' daily activity log (excerpts) on collecting clinical data

Time	Activity	Participant	Place
10:00-10:55	I called five recovered patients to collect their post-operation data such as their pain intensity, visual and urinary functions	N1, five patients	Inpatient public office
			(N1, activity log, August 2, 2023)
14:20-15:00	I talked with my patient and his wife and gave them the consent forms for their signatures to participate in my study by providing his clinical data	N2, the patient, and the patient's wife	Inpatient public office
			(N2, activity log, August 7, 2023)
7:50-8:05	I opened the office computer, read and discussed one patients' MRI data with N1, and took some notes	N3, N1	Inpatient room
			(N3, activity log, July 31, 2023)

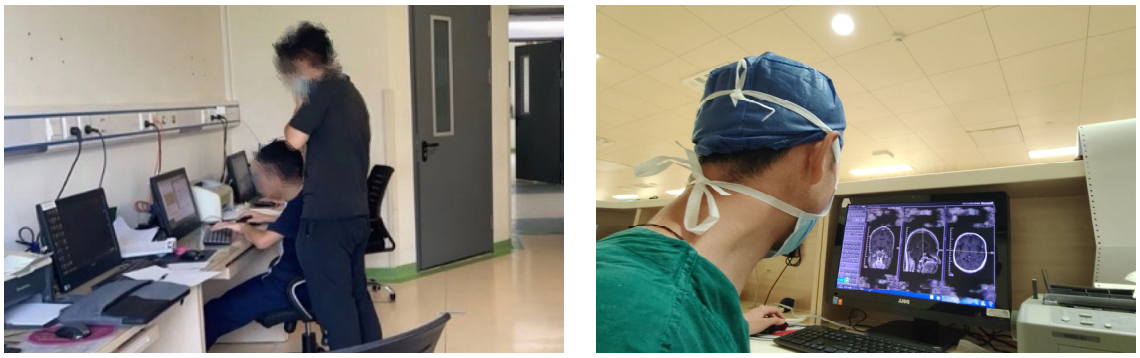

FIGURE 1. N1 and N3 (left, July 31, 2023) and N2 (right August 6, 2023) built their clinical research database in the inpatient public offices

Collaborating with Laboratories for Basic Research

Two neurosurgeons also noted that they are involved in laboratory-based basic research during their clinical practice as resident student-physicians and they eagerly wanted to publish basic research papers in SCI-indexed journals with high impact factors to improve the reputation of the department/hospital; such research may be conducted "within the hospital or through collaboration with other research institutions. As N1 and N2 said:

> My research team is collaborating with a very strong neuro-oncology research lab so we bring our tumor samples collected from daily operations in our hospital to the lab for further investigation such as molecular pathological analysis. I believe the findings can be published in good SCI-indexed journals like *Brain Pathology*. (N1)

> Only lab-based research can be published in top SCI-indexed journals because of its complex nature. It takes more time and effort compared with simple clinical patient-focused studies like case reports. So many neurosurgeons hope to have the opportunity to stay in labs and publish high-quality basic research papers to increase their research impact. I am lucky to work in a team with good connections with a research lab in my hospital. (N2)

However, N2 observed that not every neurosurgeon has the opportunity to work in labs and conduct lab-based research because such hybrid research "depends on whether your supervisor has good academic resources or strong research connections with domestic and international labs." Table 4 presents N1 and N2's daily lab-based research activities and Figure 2 contains two photographs, further illustrating how two early-career neurosurgeons were involved in lab-based research activities.

TABLE 4. Neurosurgeon's daily activity log (excerpts) on conducting lab-based research

Time	Activity	Participant	Place
8:55-11:50	I took the bus to the research lab which is affiliated to a well-known research institute to conduct molecular-level research which is in collaboration with my research team	N1	Laboratory
			(N1, activity log, August 14, 2023)
14:10-18:50	It's time for lab-based research so I walked to my laboratory which is located next to our inpatient building to conduct mouse modeling	N2	Laboratory
			(N2, activity log, August 2, 2023)

FIGURE 2. N1 conducting tumor molecular pathology studies (left, August 14, 2023) and N2 producing mouse modeling and observing mouse behavior (right, August 1, 2023)

Seizing Snippets of Time for Writing and Research Design

"Many a little makes a mickle," said N1. With this expression, N1 was implying that his small efforts could accumulate into significant findings. The early-career neurosurgeons also noted that their daily schedule was tight; therefore, N2 used every moment, even meal times, to think about his experiments, read papers, and note down any research ideas. Compared with research students, N3 mentioned that attending physicians are busier with clinical practices so they "need to figure out how to seize snippets of time for reading, writing, and publishing both clinical and lab-based research to meet the publication requirement." Table 5 shows how N2's time management strategy was used as a hybrid solution during his daily routine. It also includes my field notes taken within the inpatient office and research lab on a typical weekday. Table 5, which contains multiple sources of ethnographical data, illustrates how N2 as an early-career resident neurosurgeon strategically allocated and managed his limited time to cross between clinical and research activity systems.

TABLE 5. N2's activity log with the author's fieldnote (August 2, 2023)

Time	Activity	Participant	Place	Author's fieldnote
05:50-06:10	I got up early and walked to the canteen to buy my breakfast	N2	Dormitory, Hospital garden	/
06:10-06:20	I met another neurosurgeon in the canteen and we talked about today's clinical workload[1]	N2, another neurosurgeon	Hospital canteen	/
06:20-06:35	I ate my breakfast while I was walking to the inpatient building	N2	Inpatient public office	
06:35-07:25	*I met N1, a master student who also works in my supervisor's research team, in the public office and we downloaded some of our patients' MRI data and discussed how to continue working on our clinical research*[2]	N2, N1	Inpatient public office	
07:30-08:25	Ward inspection under supervision	N2, N1, other three senior neurosurgeons, nurses, and patients	Inpatient room	/
08:25-08:40	*I asked N1 to call 70 recovered patients to collect their post-operation data (pain rating, life quality) as the clinical data for our research*	N2, N1	Inpatient public office	I was really impressed that N1 and N2 could brainstorm and share many ideas during their short communication. They quickly made a decision - to contact some patients for writing a longitudinal study. I cannot completely follow their conversation but I think they have quick wits and clear research designs in their mind.
08:40-08:50	I asked an adolescent female patient's father for his signature to approve the operation for his daughter	N2, the patient's father, and another resident neurosurgeon	Inpatient room	
09:00-11:00	*I called the chemical company to order reagents for my lab's research*	N2	Inpatient room	/
09:00-11:20	I observed the stroke operation and helped with the operation under the supervision of the chief physician (my supervisor) and some attending physicians	N2, N3, N2's supervisor, other three senior neurosurgeons, nurses, anesthetists, and the patient	Operation room	/
11:20-11:40	I walked back from the operation room to the public office for a 20-minute rest	N2	Inpatient public office	N2 talked with me during his break about his future plan – to become a successful neurosurgeon and neurosurgical researcher.

[1] Clinical activities (e.g., ward inspection, operation/treatment, inpatient management) are underlined in the table.
[2] Scientific research activities (e.g., clinical research, lab-based research, and research presentation/writing/publishing) are italicized in the table.

				I was in awe of his committed career plan.
11:40-11:45	*I received an email requesting me to review a manuscript for a SCI journal but I declined the request because I am not familiar with the research topic*	N2	Inpatient public office	/
11:50-12:05	I ordered fast-food delivery service instead of walking to the canteen to save my time	N2	Inpatient public office	/
12:10-12:30	*I had lunch in the public office while revising the grammar issues of my meta-analysis paper's methodology section*	N2	Inpatient public office	A question arose in my mind - "don't they get tired?" N2 used his lunch time to revise his paper and finish preparing the first draft of his first-authored meta-analysis paper in the office. I also feel the time pressure as a surgeon in the hospital.
12:40-13:00	*I sorted out the patient data and sent a draft of my research paper to N3 and my supervisor for comments*	N2, N3, and N2's supervisor	Inpatient public office, N2's supervisor's office	N2 was really excited when reading patient data and told me he has some new ideas. I shared his feeling and related to my past research publication experience. He printed out his manuscript and shared it with N3 who is working in another public office. He also tapped on the door of his supervisor's office softly and cautiously. He later told me that his supervisor was attending an online meeting for collaboration and is busier than him.
13:00-13:20	My young patient's mother called me to know more about her daughter's disease and I asked for her permission to collect her daughter's data for future research	N2, the patient's mother	Inpatient public office	/
13:30-14:00	*I shared some ideas about writing a new clinical study with my supervisor*	N2, N2's supervisor	Inpatient public office, N2's supervisor's office	/
14:10-18:50	*It's time for lab-based research so I walked to my laboratory which is located next to our inpatient building to conduct mouse modeling*	N2	Laboratory	It was my first-time visiting N2's lab. I followed N2 to his lab which is located near the hospital. N2 asked me to quicken our pace to save time for his laboratory research. N2 rushed to the lab, dressed in his lab coat, and started to prepare for his experiment.
19:00-19:10	*I walked to the inpatient public office while my*	N2, N2's supervisor	Inpatient public office	/

	supervisor called me to order flight tickets for our research teams' conference presentation			
19:20-19:30	My recovered patient called me to check if he needs a follow-up treatment	N2, the patient	Inpatient public office	/
19:30-19:40	I walked to the canteen to have dinner	N2	Hospital garden	
19:40-20:00	*I had dinner in the canteen while reading one SCI paper on my phone and checked my email inbox*	N2	Hospital canteen	/
20:00-20:10	I walked to my dormitory	N2	Hospital garden	/
20:10-21:00	I talked with my roommates about their clinical work load and challenges in operation while taking a short break after a busy day	N2, N2's roommates	Dormitory	/
21:00-23:30	*I read some SCI papers online, created tables for my meta-analysis paper, and submitted a revised manuscript for academic editing*	N2	Dormitory	/

Seeking Academic Editing and Peer Feedback for Improving English Writing

N2 observed that publishing in SCI-indexed journals is challenging because English is his second language, and his non-nativelike language could affect the review decisions. N1 and N3 also explained their concerns about being L2 scientific writers and the hybrid solutions they used, i.e., inviting a third party (e.g., peers or native English neurosurgical researcher) from the clinical environment, to improve their writing quality.

N3 mentioned that many neurosurgeons in the hospital serve as anonymous reviewers for different academic journals. N3 believed he benefitted greatly from the "pre-submission peer review" which improved the clarity of his English. Table 6 presents N1 and N3's writing-related activities as they sought academic editing and peer feedback and Figure 3 further shows that N1 prepared his manuscript in the inpatient public office and sent it to an American neurosurgical professor for reading and editing.

TABLE 6. Neurosurgeons' Daily activity log (Excerpts) about improving scientific writing

Time	Activities	Participants	Place
10:10-10:50	I worked on a manuscript and sent the finalized manuscript to a native English neurosurgical professor in the USA for reading and editing	N1	Inpatient public office
			(N1, activity log, August 12, 2023)
20:00-20:30	I sent a message to a neurosurgeon in my department to see if he had time to read my paper. He agreed and I sent my manuscript via email for his comments.	N3	Dormitory
			(N3, activity log, August 8, 2023)

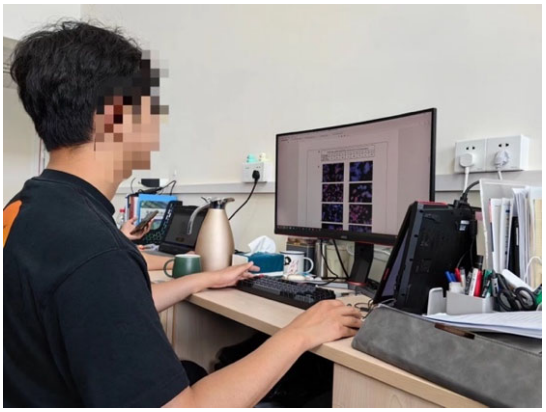

FIGURE 3. N1 revising his manuscript in the inpatient public office (August 12, 2023)

DISCUSSION AND CONCLUSION

In the current ethnographic study, the analysis focused on how three early-career Chinese neurosurgeons engaged in research despite their demanding clinical workload. Cultural-historical activity theory was employed to uncover the role of these clinician-researchers operating at the intersection of two distinct activity systems. Empirical evidence collected during the fieldwork is presented regarding their adoption of three different hybrid solutions when navigating how to connect the two systems (Li, 2014a). The first hybrid solution was to take advantage of the department to collect patient-orientated data for writing clinical research papers (Bhatti et al., 2010; Charlesworth et al., 2009). Second, they collaborated with local research laboratories to conduct lab-based research, a type of research that the early-career neurosurgeons believed

needed more time than clinical research. Third, they applied time management strategies (Li, 2014a) to squeeze time out of their busy daily clinical schedule to think about research and write scientific papers in English. Finally, similar to the results of previous studies, they sought academic language editing services (Mišak et al., 2005) or feedback from peers (Li, 2023; Li & Hebert, 2023; Wu et al., 2023) to improve their English writing and meet the writing standards of their target journals as "literacy brokers" (Lillis & Curry, 2010).

Unlike many studies on scientific writing and communication (e.g., Corcoran, 2019; Hanauer et al., 2019; Harley et al., 2014; Ren & Hu, 2023), this ethnography looks behind the scenes at a group of neurosurgeons in a unique professional healthcare setting in China. It demonstrates how early-career neurosurgeons as clinician-researchers struggling with the boundary crossing between their heavy clinical work and scientific writing in English as a second language (Li, 2014a; Ren & Hu, 2023; Zhang et al., 2020), successfully coped with their professional career balancing their clinical duties and their research. More importantly, the findings underscore the neurosurgeons' "horizontal expertise" when crossing the two distinct activity systems through their adoption of hybrid solutions. They also highlight the need for such clinician-researchers to understand the importance of English language skills for academic publishing.

Including informal language editing predominantly facilitated by native English medical professionals added an intriguing dimension to the dynamics of academic support in the neurosurgeons' scholarly publishing activity system. Notably, this practice brought considerable advantages, providing robust support for promising researchers from China. The involvement of native English professionals in reading and editing papers at a highly technical level enhanced the overall flow and readability of the neurosurgeons' manuscripts for publication in SCI-indexed journals. This form of collaboration revealed in this study underscores the importance of cross-cultural academic networks and the shared commitment to fostering excellence in neurosurgical research.

Regarding the use of patient data, although the neurosurgeons obtained informed consent before collecting data, their dual role as clinician-researchers raises potential ethical concerns because of their dominant role in providing patient care. As such, a neutral third party should obtain informed consent for clinical research trials aligned with established ethical standards and safeguards against potential conflicts of interest (del Carmen, 2005; Gupta, 2013). Even if a neutral third party is involved, ethical challenges may persist when clinicians have an interest in the outcome of the interaction and the subsequent research study. This dynamic introduces the possibility of potential conflicts of interest, especially concerning the subsequent research publication activity. Top journals tend to have ethics guidelines commonly requiring declarations of all or perceived conflicts of interest. For early-career clinician-researchers, including the three neurosurgeons in this study, this issue should be explicitly declared when they publish their research using patient data.

Moving forward, it is imperative to consider the broader implications of these findings for medical professionals navigating similar dual roles globally. Understanding the strategies employed by early-career neurosurgeons to overcome challenges in scientific publishing can inform the development of tailored support systems and training programs. Echoing Ren and Hu's (2023) proposition, medical institutions and policymakers in China and beyond may need to acknowledge and facilitate the integration of scientific research into the daily lives of medical professionals, especially those at the outset of their careers.

The current study contains limitations that may affect the claims regarding the

perceptions and experience of Chinese clinician-researchers and their boundary crossing between clinical work and scholarly publishing. The neurosurgeons were either relatively young attending neurosurgeons or pursuing master's and Ph.D. degrees as resident physicians. Thus, perceptions about their scientific publishing would likely be different than those of senior neurosurgeons, neurosurgeons who are either full-time clinicians or researchers, or clinician-researchers in lower-tier hospitals in less privileged cities. In this sense, the study captured only a narrow subset of scientific publishing among clinician-researchers in the medical field. Future research should consider widening the scope of medical fields and use methods other than interviews and observations such as narrative inquiry, a longitudinal approach, and quantitative surveys with multiple sources of data for triangulation, which may provide valuable insights about the scientific publishing experience of clinician-researchers and their perceptions and experience of boundary crossing between clinical work and scholarly publishing.

In conclusion, this study serves as a pioneering exploration of the intricate dynamics encountered by medical professionals navigating the intersection of clinical practice and scientific research. Examining the strategies employed and challenges overcome by medical professionals, the study establishes a foundation for future empirical research and interventions aimed at supporting global clinician-researchers in attaining a balanced and successful professional and academic career.

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