

Focus on China: should clinicians engage in research? and lessons from other countries

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Abstract: Following tremendous economic progress, society in China is also undergoing fundamental changes, as is the healthcare system. Currently the training of Chinese young doctors and their future work placement are all undergoing re-structuring. We compiled some thoughts and opinions on the topic of ‘should clinicians in China engage in research?’, and publish them as a special report in this issue of *Quantitative Imaging in Medicine and Surgery (QIMS)*. The contributors included some editorial members of this journal, and a few personal friends. Besides a few minor linguistic corrections, opinions from the contributors have not been edited, as we want authors’ to write their own independent views. However, it is possible there is a selection bias of the contributors of this paper; more likely those who are interested in the medical research are selected and therefore the views of the contributors may not be generalizable. To compare the structure and funding of China with other countries, authors from UK, The Netherlands, France, and USA are also invited.

Keywords: China; Chinese; doctors; medical research; medical training; research funding

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Introduction

Following tremendous economic progress, society in China is also undergoing fundamental changes, as is the healthcare system. Currently the training of Chinese young doctors and their future work placement are all undergoing restructuring. We compiled some thoughts and opinions on the topic of 'should clinicians in China engage in research?', and publish them as a special report in this issue of *Quantitative Imaging in Medicine and Surgery (QIMS)*. The contributors included some editorial members of this journal, and a few personal friends. Before providing their opinions, the following points were to be considered (I) need to provide the reason for opinions; (II) take into account of the development stage of China. It is not a well developed, wealthy state yet; (III) 'Research' here means clinical research or fundamental research, and a clinician is considered to be engaged in research when he/she spends at least more than 4 hours per week on research. He/she should be proactive in the research process including reading relevant literatures and forming hypothesis. To write a few case reports occasionally or passively submit some patient data cannot be considered to engage in research; (IV) It is likely to be wrong by stating that 'no clinician should engage in research', or 'every clinician should engage in research'. The percentage of clinicians in China should engaged in research, or clinicians of which posts should engage in research, should be discussed; (V) if a clinician is employed full time for clinical practice, the concern on who should pay for the time spent on research may be raised as this would be a problem when a clinician spends 2 or 3 days per week on research. One possible choice will be that a clinician can engage in research only when he or she has spare time. Besides a few minor linguistic corrections, opinions from the contributors have not been edited, as we want authors' to write their own independent views. However, it is possible there is a selection bias of the contributors of this paper, more likely those who are interested in the medical research are selected and therefore the views of the contributors may not be generalizable. Our intention in initiating this paper was neither to take part in the debate, nor to make any judgment about the merit of the medical research, but to clarify the dimensions of the debate, and thereby contribute to the community's reflections regarding the future direction of medical research activities in China. To compare the structure and funding of China with other countries, authors from UK, The Netherlands, France, and USA are also invited.

The positive views by Dr. Zhongheng Zhang, China

Since the opening up and reform policy, China has made great progress in economics and areas of science and technology. Likewise, the biomedical area witnesses similar progress. More and more clinicians start to get involved in medical research, including both clinical and fundamental research studies. Furthermore, research achievements, measured by the quality and quantity of scientific papers (indexed by ISI web of science) and funds, are incorporated into the promotion system of clinicians (1). Such policy is implemented at two levels: one is performed at the state level that requires clinicians to publish >2 or more scientific papers in local Chinese journals; otherwise the clinicians are unqualified to apply for higher grade positions (e.g., the Chinese licensing system in ascending order is: resident, doctor-in-charge, associate principle doctor, and principle doctor). The other is at the hospital level that varies by different levels of hospitals. For promotion to higher grade, tertiary teaching hospitals usually require staff clinicians to have >2 scientific papers published in science citation index (SCI)-indexed journals (and some hospitals require the total impact factor to be more than 5 points) and one awarded grant from national natural science foundation of China (NSFC). The number of scientific papers from mainland China has increased exponentially since the implementation of this policy (2).

The issue of whether clinicians should engage in research has triggered tremendous debate in recent years. Some clinicians argued that clinicians should focus on treating and communicating with patients, instead of engaging in feeding mice and culturing cells (3). Doctors can be promoted to the highest level (principal doctor) by publishing many papers and obtaining major funds, but they are less experienced in treating patients. Such examples are usually taken by opponents to bash the promotion system which has placed too much weight on scientific research. However, I disagree with such arguments and contend that doing scientific research is essential for a good doctor.

Firstly I would like to distinguish clinical research and fundamental research because many clinicians are confused with these two distinct research fields. When I talk to someone about doing research, they usually refer to laboratory work. Clinical research involves human subjects and it is more relevant to clinicians. The research question can be categorized as explorations into risk factors, causal relationship, effectiveness of interventions and

epidemiological studies. These questions are encountered during routine clinical work. However, fundamental research differs significantly from the clinical work. In western countries, fundamental research is done by specialized PhD investigators and not typically by clinicians (4). Concepts, ideas and working style can be markedly different between clinical work and laboratory research. Therefore, I feel that doing clinical research is essential for clinicians, but some laboratory researches are not so relevant.

The paradigm shift of clinical medicine from experience-based to evidence-based medicine requires a good clinician to think like a scientist. That is to say, we should make our treatment decision based on evidences derived from data analysis rather than one's own experience, because such experience can be biased. Clinical medicine is a combination of science and art. The former pertains to things with definitive conclusions supported by empirical evidence, whereas the latter refers to some ambiguous area without strong evidence. Decision making in areas without definitive evidence is based on the judgment of the physician by taking into account the patient's preference, financial issues and religious consideration. For instance, early initiation of antibiotic therapy is essential for patients with septic shock, and this cannot be delayed by any "art". On the other hand, the conventional experience-based medicine is largely dependent on the personal thoughts or ideas of the treating physician, which is more of the "art" aspect of medicine. The paradigm shift indicates that the clinical decision making becomes more and more dependent on empirical evidence. There are many figures and tables in original articles, and conclusions on a particular clinical question are always conflicting. A good clinician who wants to keep up to date and provide best treatment to his/her patients must have knowledge on the performance of clinical research. That is to know how the conclusion from each study is obtained. Only in this way the conclusions can be appraised critically without confusion. Statistics and epidemiology are among the most important subjects for critical appraisal of literature. The best way to fully master the knowledge is to take part in clinical research. Otherwise it is difficult to integrate one's way of thinking into the paradigm of evidence-based medicine.

Someone may contend that China is still a developing country with limited resources, and it is impossible for every clinician to participate in research activity. This statement is true for fundamental research, but not so for clinical research. The point is that every patient can be viewed as a subject in research, except that he/she refuses to participate

in the study. China has the largest population in the world and can make great contribution to clinical research in this regard. Chinese doctors are the busiest in the world and one doctor typically has to see 100 patients 1 day (8 hours), so clinicians have good resource for doing clinical research. The concern is not whether Chinese clinicians should engage in research but how to make full use of the resource. One advantage is to use the electronic medical record (EMR) system which has already been used in nearly all hospitals in China. The information of laboratory findings, demographics, imaging studies and follow up results can be easily extracted from EMR. The EMR can produce large amount of information that cannot be handled manually, which has been termed "big data", and big data is helpful to answer many unresolved clinical questions (5,6). Another way is to get involved in multi-center clinical studies, in which every clinician can contribute to the study once his/her patients fulfill inclusion criteria and are willing to participate in the study.

In conclusion, clinicians in China should get involved in clinical research and this is not limited by resources. The experience of doing clinical researches allows clinicians to think critically on the emerging large amount of research papers, and provide the best treatment for patients.

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Medical research in the UK, by Dr. Gavin Winston, UK

Medical research forms a key part of the medical system in the United Kingdom. The National Health Service (NHS) formed in 1948 is publicly funded from general taxation with the majority of services delivered free of charge to residents. As the NHS delivers the vast majority of medical care, the private and charitable sectors form only a small part. A wealth of data are thus available in the NHS covering most diagnoses and treatments.

The National Institute for Health Research (NIHR) was formed in 2006 as part of the government strategy for health research (7). It is a part of the NHS and was designed to bring together previously separate programmes and co-ordinate and fund scientific research that can be readily translated into clinical benefit in this environment.

A large quantity of anonymized linked data are collected

within the NHS which can be used for observational research. Within England, this has recently been made available to a wider range of researchers via the Clinical Practice Research Datalink (www.cprd.com). Analysis of these data has led to around 900 papers to date.

More basic preclinical science and early stage clinical studies are generally conducted within universities and the pharmaceutical industry. Funding for university-based research typically comes from the Medical Research Council, a publicly funded government agency, the Wellcome Trust, a large charitable foundation supporting medical research or any of the numerous charities representing specific diseases.

Many of the researchers are drawn from abroad, particularly Europe but also farther afield due to the international standing of research output from the UK. There is however a significant lack of medically trained doctors performing such research in the UK. There could be several reasons for this.

A significant change introduced by the government in 2005 (Modernising Modern Careers) was designed to modernize the career structure of doctors in training. However there were widespread problems including a significant emphasis on rapid “run-through” training of doctors to increase consultant numbers, which also provides barriers to those wishing to undertake research. With essentially a single employer of doctors in training, the NHS, special permission must be sought to spend time in research and this is not always supported.

There is no clearly defined academic career structure in the UK and it is difficult to balance clinical and academic training. These problems were identified in a report by Sir Mark Walport, Director of the Wellcome Trust and recommendations were made on how to address this (8). In response, the NIHR does fund some training posts that include both clinical and academic components but there are limited numbers and the identified problems remain a concern.

In the last few years, significant funding cuts have occurred in the academic environment, leading to cuts in the number of academic posts. The security of tenured posts as are common in other countries was largely removed years ago so the employment of those wishing to work within medical research is always at risk.

Dr. Gavin P. Winston is a neurologist at the Epilepsy Society MRI Unit, Chalfont St Peter and affiliated with the Department of Clinical and Experimental Epilepsy, University College London (UCL) Institute of Neurology,

Queen Square, London, UK. His research concentrates on patients with refractory epilepsy undergoing neurosurgical treatment, predominantly anterior temporal lobe resection. Using diffusion tensor imaging, he has evaluated the effects of epilepsy and surgery on cognitive function and have shown that real-time image-guided surgery in an operative MRI suite reduces the risk of visual field deficits. He made available a free online automated hippocampal segmentation service (<https://hipposeg.cs.ucl.ac.uk>), and he is now working on improving the detection of the underlying abnormality in patients with normal conventional MRI scans using novel contrasts and computational analysis. Dr. Winston received the Sir Peter Mansfield Prize for innovative technical developments in the field of magnetic resonance in medicine and biology from the British Chapter of the ISMRM in 2011 and his work has featured in the BBC television programme “How Science Changed Our World”. Dr. Winston is a member of the editorial board of the journal *QIMS*.

Each one in his/her place, by Dr. Hai-Tao Zhao, China

In clinical practice, doctors will encounter many problems which might not be fully explained by the existing knowledge or theory. Out of curiosity for the unknown, clinicians will make their efforts to solve these problems through observation, analysis, and practice. This is what we call research. When a doctor meets something interesting, he will spontaneously invest large amounts of time and energy, his mind will be more creative and the output of his research will be more abundant than being compelled to do so. However, a large number of clinicians may be more willing to focus on patient care and the continuous improvement of medical skills. So, the policy demanding every clinical doctor devotes to scientific research is not reasonable, because it has violated the people of goodwill and free nature. Therefore, every doctor can do research, but not all have to do research.

Because of its large population and the developing stage, China's national health investment still cannot meet the needs of the people. Moreover, China is in a period of tremendous economic progress and fundamental change of society, institutions need to constantly update to adapt to the demand of people. So it is the healthcare system. At present, because of its direct relation to the career promotion, every Chinese doctor must participate in scientific research, which led to a huge waste of manpower

and material resources and the poor reputation of Chinese medicine scientific research. Out of China's present situations and my personal experience, I think having 10-20% of clinical doctors engage in research could be more reasonable. First of all, China is a populous country with shortage of medical resources. Clinicians, as members of the society, should finish their duty in the first place. Secondly, lack of reasonable system of rewards and penalties had led to the emergence of a variety of academic misconduct, while a doctor who really committed to innovative studies could not get the corresponding support and therefore unable to proceed his work, which ultimately affect the competitiveness of the entire Chinese medicine scientific research. Therefore, more reasonable system should be established to ensure clinicians who devote themselves to research get sufficient time, space, and financial support, and those who are committed to the clinical work not to be distracted.

Research and clinical work should be evaluated through different and independent standards. Articles and patents will be the key indicators for those who engage in research work, while the level of medical skills and workload for pure clinicians. Meanwhile, the role of researcher and clinician are not invariable. Doctors can change their focus of work in different stage of career.

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Medical research in the Netherlands, by Dr. Edwin Oei, The Netherlands

Compared to other Western-European countries, medical research in the Netherlands has traditionally performed above average in terms of productivity and impact, and has consistently appeared in high positions on several rankings of scientific output and citations published over the past decade. This situation, however, is being challenged by a steady decrease in government investments in scientific research (expressed as percentage of gross domestic product), which has led to a tremendously increased competitiveness for third party research funding. Due to the worsening funding climate, recent figures show that the Netherlands is gradually losing competitiveness against other countries, especially those that have systematically

increased financing of research and development. There is a trend towards more medical researches being embedded in multi-national projects and consortia funded by European grant mechanisms.

All current generation Dutch clinical specialists are to a certain extent familiar with the concepts of clinical research, as theoretical education (e.g., in clinical epidemiology, biostatistics, and critical appraisal of literature) as well as the completion of a research project (up to 6 months) constitutes an important component of the medical curriculum at all of the eight Dutch medical schools. In the Netherlands, there is great competition to enter a postgraduate training program in the desired medical specialty and it is uncommon to enroll in a medical residency program straight after obtaining the medical degree. Following medical school, many young medical doctors engage in scientific research in their field of interest in order to further familiarize themselves with the specialty, obtain more experience, and increase chances of being accepted in a residency program. As a result, there are a substantial proportion of Dutch medical specialists that have also completed a PhD program with a typical duration of 3 to 4 years.

The degree of involvement in research by Dutch clinicians varies and is largely dependent on the environment in which they decide to pursue their career. Some clinicians, especially those who have completed to a PhD degree, may choose to stay involved in research and start an own research line, typically in an academic center, of which only eight exist in the Netherlands. In academic centers, the majority of clinicians engage in research, but the level of involvement is variable and ranges from participation in clinical trials to the leadership of an own research group with graduate students and research support personnel. There are, however, also academic clinicians who do not perform research, but may choose to focus on education or patient care. Depending on the department, it may not be necessary to be actively participating in all three pillars of an academic medical institution—patient care, research, and education.

Most Dutch clinicians will, directly following residency or later in their career, practice in a non-academic hospital or one of few private clinics. In non-academic hospitals, it is possible for many clinicians to still engage in research, although emphasis on efficient and productive patient care and resulting time constraints are often an issue. The vast majority of medical research in non-academic hospitals is conducted in the context of a multicenter study with

one of the academic hospitals acting as the coordinating center. Occasionally, it is possible for clinicians working in non-academic hospitals to perform a “stand alone” clinical study, although this may be challenging because of aforementioned issues and the fact that the research is not embedded in a research infrastructure with adequate resources and research support.

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Dr. Qiyong Ai's view on clinician's engagement in research, by Dr. Qiyong Ai, Hong Kong

In China, many hospitals, especially hospitals affiliated with universities, encourage clinicians to do research for promotion instead of personal interests. More publications mean easier to be hired or recommended to promotion for both general practitioners and specialists. Under the pressure related to promotion, many useless or fake publications appear in Chinese journals. This phenomenon reduces the China's prestige in international research arena, and leads to a notorious situation in clinical research in China.

In my own opinion, clinical research should be encouraged for each specialist who is more knowledgeable in their own definitive area. As a professional occupation for saving lives, clinicians not only need to take the responsibility of disease prevention, disease treatment but also the obligation to do clinical research for the investigation of causes of diseases. Their current and latest publications containing the doubts and oppositions with the old views can provoke inspirations to scientists and other clinicians for further research for better detection of the pathophysiological relationships so that disease can be managed more efficiently.

There is great variability in the presentation of symptoms and signs for a certain disease. Clinicians are the ones who see the patients and observe the changes of diseases with high frequency. So it is easier for them to record and accumulate the patient documents for clinical

research. Because of the diversities in professional levels of clinicians, for the same case different results may be recorded by different clinicians. In these situations, a specialist is more competent for clinical research in their specific areas because of their deep understanding of disease pathophysiology. Specialists can analyze cases more profoundly. Therefore I support clinical studies performed by specialists, not by generalists.

In the meantime, specialists need to broaden their professional knowledge in specific areas and update their concepts for specific diseases. During the clinical research, clinicians should review previous knowledge that may be rarely applied in clinical work, read the latest publications, and also keep up with the international progress and development on specific diseases.

In addition, China has a large population, which means many different diseases will be seen more frequently comparing with other countries. China is an excellent country to do clinical research. Larger samples decrease the errors in statistical analysis. Unfortunately, China lacks a systematic network for sharing the patient resources which leads to large amount of sample loss eventually.

About research time, I would like to recommend collecting cases while doing clinical work. Four to ten hours per week for clinical research is preferable during the working time. However in China clinicians are required to spend lots of time in patient history recordings and other trivial duties due to a lack of enough manpower. China clinicians are usually tired or even exhausted when finishing their clinical duties at late night, and may become less energetic to continue to do clinical research.

But I still prefer to advocate that specialists should engage in clinical research. After all clinical research is good for a clinician's self-improvement and the medical science development.

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Medical imaging research in France, by Dr. Romaric Loffroy, France

Features of clinical research in medical imaging in France, which is organized around two major national structures (CNRS or National Center of Research in Health and INSERM or National Institute of Health and Medical

Research) are summarized below:

- A position of excellence in research in medical imaging: more than 1,100 statutory researchers and 650 doctoral candidates and post-doctoral fellows work for development of innovative technologies in the medical imaging sector. They are located in about a hundred research centers, which are mainly concentrated in six big regional poles. With more than 4,205 scientific publications in 2006 and 2007 (i.e., 5.3% of world publications), France is in a position of excellence in research in radiology. Another indicator of excellence and academic dynamism in medical imaging is the important number of structures or projects funded by the program of investments with prospects. Among these structures, one targets development of programs focused on immersion and interaction with image, efficacy of fixed and mobile networks, future internet and digital health. About forty laboratories are specialized in medical computer science and about twenty in diagnostic agents and target scanners, as well as in detectors and molecular imaging. Research centers benefit from high technology equipment as, for example, the "Arronax Plus" platform focused on the development of molecular imaging and vector-based radiotherapy.
- An academic research on the structuring way: within the framework of the Euro-BioImaging European initiative, France is equipped with two national networks of imaging platforms with high potential of research and development, from platforms certified by the Scientific Interest Grouping of Biology, Health and Agronomy Infrastructures: France Life Imaging (FLI) dedicated to *in vivo* imaging research; France BioImaging (FBI) focused on cellular imaging research. These two structures have as one's ambition to favor scientific cooperation and training course, to give access to advanced imaging techniques to the scientific community, and to take part in the economic development of the territory in giving impetus to industrial partnerships.
- A dense clinical research organized in network: France also displays the will to promote and facilitate clinical studies by the pattern of the 53 Clinical Investigation Centers (CIC), located in the University Hospitals, within the F-CRIN national network (French Clinical Research Infrastructure Network) which represents the French participation to the E-CRIN European network (European Clinical Research Infrastructures Network).

About 220 clinical trials in the field of medical imaging are currently conducted within, mainly on three therapeutic axes: neurology, oncology and cardiology. In parallel to F-CRIN, a French network of eight CIC-TI (Clinical Investigation Center-Technological Innovation) and five partner cities is building oneself. This network targets medical devices, computer-aided medical and surgical procedures, e-health and biomaterials. Imaging has a key role within this structure as long by the development of particular techniques of acquisition as by the development of specific software. There are notably five CIC-TI: one dedicated to magnetic resonance imaging; one focused on nuclear medicine and ultrasound; one dedicated to diagnostic and therapeutic devices; one specialized in e-health; and one focused on computer-aided medical and surgical procedures.

Dr. Romaric Loffroy is a Professor of Vascular, Oncologic and Interventional Radiology, Le2i UMR CNRS 6306, Bocage Teaching Hospital, University of Dijon School of Medicine, Dijon Cedex, France. His field of expertise is in interventional radiology, especially in embolization techniques with particular interest in gastrointestinal bleeding as well as peripheral vascular diseases. He has been at the fore front of newer and more successful techniques in embolization of gastrointestinal bleeders which reduce the failure rate as well as the necessity of reinterventions. Dr. Loffroy is currently doing research in improving tumor imaging quality in interventional radiology and working towards newer interventional radiology therapies for liver cancer. Dr. Loffroy is a member of the editorial board of the journal *QIMS*.

Dr. Ting Lin's view on clinician's engagement in research, by Dr. Ting Lin, China

Clinic work or scientific research, which is more important for clinicians? Whether clinicians should do scientific research or not? These are questions puzzled clinicians in China in recent years.

Conventional concept suggested clinicians' duty is mainly to do a good job in health care, and most of their energy should be used in clinical work. Their ability to do research is far from being recognised compared with researchers specialized in fundamental research. But in fact, there is a lot of experience accumulated during their years' clinical practice, which is far beyond reach of the basic researchers. Putting forward research ideas in practice by clinical worker

often is the recognition of disease process's nature. The clinicians who come up with good and practical assumptions are able to explore the unknown medical fields.

Clinicians can be divided into three types. The first one is clinician, the second one is scientific physician, and the third one is physician scientist. Physician scientist is the bridge connecting clinical medicine and basic science. Physician scientist must be a qualified physician, having solid clinical fundamental skills, profound knowledge of clinical medicine and rich experience. Meanwhile, physician scientist must receive strict training in basic science and in research methodology.

With the development of human society, clinicians must follow the scientific principles and evidence in dealing with the medical problems, not only simply relying on experience. Clinical care needs evidence-based medicine, which integrates the best research evidence with clinical expertise and value of the patients. For clinicians, the initiation of doing research should come from real clinical problems. The inner impetus should be the interest of finding solutions for clinical issues. In China currently the evaluation of professional title and the assessment for the clinicians are based on the scientific papers and projects. This mechanism resulted in forcing clinicians to engage in scientific research for promotion purpose. Clinical duties bring tremendous pressure on clinicians already and they also need to read literature after day time's hard work. Now in China most of the clinicians regard scientific research as completing compulsory tasks; and do researches separated from reality, rather than find solutions for clinical issues. Not all clinicians need to do research. The clinicians with limited resource or clinicians who are not interested in scientific research should not be required to participate in research. In USA clinical teaching hospitals clinicians are divided into clinical-oriented and research-oriented types. Clinical-oriented doctors give priority to clinical work, while research-oriented doctors have 2 or 3 days a week dedicated time for scientific research.

Clinic work is the source of research and clinical research guides the clinical work, and they should be highly integrated. The value of clinical clinicians in research should be embodied in the following two aspects: one is to heal the wounded, rescue the dying, improve the quality of medical treatment. The other is to advance the development of medicine.

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Do good research, or save the time for patients: in China medical research should be performed by a smaller number of dedicated doctors, by Dr. Yi-Xiáng Wáng, Hong Kong

Currently in China there is a passionate debate about whether doctors should do research (3,9,10). To serve the patients and do a good research are both very demanding, it is difficult, or sometimes impossible, to have a good balance of the both. Lots of knowledge had already been gained in medicine, and more are being published almost everyday by researchers over the world. For the majority of doctors, to improve their knowledge frequently, to have a good command of what has already been known would be sufficient to qualify as a good doctor. When I attend conferences I often find that I cannot keep up with the latest developments.

I believe less than 5% of doctors in China should actively do research. For the doctors who do research, they should be given a lot of support, and partially or even completely exempted from clinical duties. In the meantime, their research output should be evaluated according to (I) world-leading, (II) internationally excellent, or (III) recognised internationally. Redundant studies and studies with theory and methodology errors, which unfortunately are still common (11,12), should be closed. Research grant application can be written in English and reviewed by international experts. This is what Hong Kong is doing. The majority of doctors employed by the Hospital Authority of Hong Kong do not do research, while the small percentage of physician scientists employed by the two medical schools in Hong Kong do lots of researches (13). Despite the small size and limited budget, both medical schools are ranked very favorably internationally (24th for the University of Hong Kong and 49th for the Chinese University of Hong Kong, according to Quacquarelli Symonds (QS) World University 2014 Rankings) (14).

Currently in China many trainee doctors are required to do research by themselves without proper guidance. I trust Chinese young doctors will feel self-satisfaction and enjoy research if they can do good science which truly explore the pathophysiology of human diseases or develop clinical strategies that positively influence patient care. Heavily funded Chinese institutions can have oversea branches. For example, the RIKEN (Rikagaku Kenkyūsho, the Institute of Physical and Chemical Research of Japan) has oversea research facilities; the Fraunhofer Society of Germany has research sites in US. This will improve the competition

among research sites, and help to select the best research leaders at international level. The effectiveness of oversea sites and the sites in mainland should be compared periodically. China can also have more international staff as research directors. As an example, the current Vice-Chancellor (president) of the University of Hong Kong is a British Urologist. In the field of research management, China has a lot to learn from countries such as Japan. In short, do good research, or save the time for patients.

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Dr. Yaxing Shen's view on clinician's engagement in research, by Dr. Yaxing Shen, China

In China, the research is considered as a heavy burden on doctors over clinical affairs. This is quite the same as other kind of heavy burdens on the doctors including the overpriced houses, the disordered healthcare system. The only difference is that doctors have choices to the burden of research. They could choose to neglect the research, since it will not lead to homeless, to iatrogenic injury or the death of the patient. So why shall clinicians engage in the research?

As a surgeon, I would definitely vote for "No" if research was nothing but a heavy burden. I had a colleague in my department who unluckily failed the exam after the clinical rotation. This colleague was required to do the research for about two years and then later returned to the clinical duties. Research was taken as a "punishment" to the clinician in this case. The results were not satisfactory as you expected. The unhappy surgeon spent two years playing with DNAs and RNAs, but no paper was accepted. Once upon a time in China, there was a period when the steel was considered the most important material to the country, almost every family donated their own iron containing household to be forged to steel. The SCI papers are the "steel" now to the doctors in China. To make more 'steel', many doctors choose to concentrate on cells, signals, and pathways, leaving the patients less cared. Even though every doctor claims that his/her research will benefit the patients someday in the future, the patients right now are neglected. The "steel" forged remains useless just like the steel forged during the Culture Revolution period in China.

In the future, what we need are surgeons who care patients and manage patients scientifically. I am a surgeon,

so I will do my research on surgery and publish in the journals with the terms of "Surgery" or "Surgical". If we require 'steel', then we need real 'steel' that is useful to the surgeons and their patients.

Dr. Yaxing Shen is a thoracic surgeon in the Zhongshan Hospital of Fudan University, Shanghai, China. As an attending surgeon, he is dedicated to the surgical affairs in an academic style. His research interests include minimally invasive surgery and esophageal cancer. He is recently awarded Evarts Graham memorial fellowship 2015-2016 by American Association for Thoracic Surgery.

Funding situation for academic radiology in the United States, by Dr. Chin K. Ng, USA

A clinical department such as Radiology in the United States usually consists of two types of faculty-clinical and research. In the midst of continuous slash of fund throughout the last decade, the operating budget provided by the state to the radiology department can be less than 5% across the United States. Thus an academic Radiology department is expected to be largely financially independent even if it belongs to a medical school in a state-funded university.

Because of the ever changing health care environment in the United States, the clinical dollars for an academic Radiology department have been shrinking for some time. Part of the clinical dollars has been used to support research in the department, but the flexibility is no longer there in recent years. Clinical faculty is expected to spend most of their time in revenue generating exercises in the clinic. Quite often, administrative days can no longer be used to conduct research, but are used rather to catch up with clinical cases and paperwork for reimbursement claims to the insurance companies. The performance of a clinical faculty is largely measured by Relative Value Unit (RVU) based compensation arrangements which are historically common in group practice. RVU systems are payor-mix neutral. Clinical faculty also generates income to the department through participating in clinical trials sponsored by pharmaceutical companies, federal grants, foundation grants, or other sources. In order for the clinical faculty to promote to the next rank, he/she will need to demonstrate his/her ability to generate clinical revenue through clinical work and/or clinical trials in addition to the number of service years in the department. A clinical faculty on the tenured track is also expected to publish articles in peer-reviewed journals or to participate in scholarly activities through publishing book chapters or books.

For a research faculty, the options are usually much narrower. Some academic radiology departments require him/her to support up to 95% of his/her own salary. Even for a tenured faculty, only the base salary is guaranteed. This base salary is determined by the individual medical school and has been kept shrinking year after year. Support for salary and research largely comes from the National Institutes of Health (NIH), but the pay line has gone below 10%, thus many seasoned investigators have been struggling to keep their laboratories open. Other sources of revenue for research faculty can be extracted from the National Science Foundation (NSF), various charity foundations, Small Business Innovation Research (SBIR) program, Small Business Technology Transfer (STTR), and state grants. Expensive instruments can be obtained through the NIH shared instrumentation grants, although the success rate is rather low. Promotion to the next rank will be determined by the likelihood of supporting their salary and their laboratories.

Although the current environment is very challenging for both clinicians and researchers in an academic radiology department, the infrastructure is still in place for those who would like to engage in research. Since molecular imaging plays a key role in medicine, an academic radiology department is uniquely positioned to introduce the medical imaging techniques to other disciplines beyond the four walls of the medical school. The American Board of Radiology (ABR) has now asked the radiology residency programs to include research as part of the training.

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Dr. Hua Liu's view clinician's engagement in research, by Dr. Hua Liu, China

In today's China, whether doctors should engage in scientific research depends on different situations. Different hospitals should correctly handle the relationship between clinical work and research according to their own actual situations. For staff in the countryside medical institutions, township hospitals and village clinics, it is unrealistic, unnecessary and wasteful if they are asked to perform scientific research. Meanwhile, they provide numerous people with healthcare services in the vast rural areas in

China. Their main task is to provide the basic healthcare rather than to do medical scientific research. My viewpoint is that these medical staffs should not engage in research.

There are a lot of big medical institutions in mainland China apart from basic medical healthcare service network. In addition to providing medical services for surrounding areas, clinical medical scientific research should be the main task in these big institutions. There are a large number of medical elites in these hospitals due to historical and realistic reasons. During clinical practice, they encounter a lot of medical problems which will inspire their scientific ideas and encourage them to study. At the same time, hardware and software conditions in these hospitals meet the requirements for scientific research. These medical elites have advantages in research: rich resources of the patient, good research platform and open scientific research information. Therefore they should focus on medical research, especially for the doctors in the affiliated hospitals of medical schools.

The main contributors of medical scientific research in our country are the research personnel in the medical schools. There is still a problem compared with the West, that is medical researchers in Chinese medical schools cannot fully integrate fundamental medical research with clinical practice. In some research institutions in the West, some researchers spend part of their time in laboratory work, while devote other part of their time in clinic. This helps to keep and maintain their research enthusiasm. It is more suitable for medical elites in big hospitals in China to engage in medical research.

In summary, different medical institutions should determine their ratio of medical research to clinical work according to the actual situation of their own, of course, personal interests should also be considered.

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Dr. A. Cahid Civelek's view on clinician's engagement in research, by Dr. A. Cahid Civelek, USA

The background, specifications and qualifications of the relevant country, the institution and the physicians are major factors to be considered in making a decision for conducting research.

The types of Research generally are classified as: (I) Wet bench (pre-clinical, basic science) research, (II) Transitional

research, and (III) Clinical research, which in most instances may be observational.

Basic science that is pre-clinical wet bench research is most suitable to be conducted in major academic medical centers since they are able to provide necessary appropriate platforms that include the physical and financial infrastructure as well as manpower with necessary knowhow. In the USA most of the major academic centers fulfill such research activities through their “two tier systems” in academic evaluation and promotion of their academic faculty. However there are few academic medical institutions exist keeping a single tier system with expectation of perfection in Patient care, Research and Teaching; an example is the Johns Hopkins Medical Institutions in Baltimore, Maryland.

Transitional research is also more appropriately conducted in such large academic medical centers for the same reasons as mentioned above.

In reality, once the culture of basic science is established in an academic institution, the ‘cost’ of conducting basic research becomes self sufficient through the secured extramural grants. Almost all basic science research in major academic centers of the USA is financially self-sufficient. They rely on investigator generated extramural grants, except for a short-term ‘rainy day’ situations that may occur.

On the other hand, even the most clinically oriented physicians should be expected to participate and/or execute “Clinical Research” in any form, level. Even most simple observational clinical research has a potential to improve patient care, safety and overall medical improvements.

Several examples for such ‘clinical observation’ based research resulted in development and/or establishment of several clinically very relevant and essential medical improvements in emergency departments listed below:

The ‘Observation Beds’ that existed in few Emergency Departments in the 1960’s and 1970’s progressed into having full time Emergency Physicians on site as it happened in Brigham Hospital, Kansas City General and UCLA-Harbor hospitals. These units later resulted in the birth of *Observation Medicine* and *Observation Units* in emergency departments (ED). As of 2007, 36% of the emergency departments in the USA had an ED based Observation Units, serving 13% all patients admitted to ED. The safety, efficacy, cost effectiveness of such units has been proven.

Similarly, development of Emergency medical Services (EMS) in today’s format as well as the establishment of emergency department Chest Pain Units (CPU) in the USA

were based on simple but astute observations of ‘clinical physicians’ working in rural area local hospitals.

I like remind one of the quotations a Greek Scientist physician Hippocrates (c. 460-c. 370 BC):

“Leave nothing to chance, overlook nothing: combine contradictory observations and allow enough time...A great part, I believe, of the art is to be able to observe”.

The research is a crucial aspect of the medical sciences and hopefully every member of the medical community takes part in it one way or another.

Dr. A. Cahid Civelek is a staff radiologist at Department of Radiology and Imaging Sciences, Clinical Center, NIH, Bethesda, Maryland, USA. Dr. Civelek is a member of the editorial board of the journal *QIMS*.

Dr. Zhijun Han’s view on clinician’s engagement in research, by Dr. Zhijun Han, China

Nowadays, the medical environment become more and more complex, the heavy clinical work results in lack of time and energy for research. It is too difficult to do both clinical work and science research. So how to choose?

In fact, medical practice and research are complementary to each other instead of being opponent. The busy and repetitive clinical practice makes us familiar with our daily work quickly, but if we do the same thing in daily clinical practice without critical appraisal of what we have done, we would be lack of innovative motivation and creative thoughts. A doctor who only undertakes clinical work can only be regarded as a clinician, while the one who can transform their own clinical observations into research hypotheses and in turn, use the research to improve patient care should be called a clinical scientist.

Although reformation of medical treatment has lasted for years, research and writing paper might accompany us for the whole career life. We should make use of our spare time to ‘do’ rather than ‘complain’. Improvement will come no later than half a year and we can be clinical scientists finally.

Dr. Zhijun Han is a principal investigator of several research projects supported by NSFC, The Clinical science and technology project of Jiangsu Province, Wuxi science and technology project research project, etc. He won the medical new technology award by Jiangsu Province. He has published more than 20 articles in journals such as *Anal Biochem*, *Clin Exp Med* and *Clin Biochem*. Dr. Han is with Department of Laboratory Medicine, The Affiliated Wuxi Second Hospital of Nanjing Medical University, Jiangsu Province, China. His research focuses on the mechanisms

of autoimmune disease, the new circulating biomarkers for autoimmune disease diagnosis and prognosis.

Should doctors be engaged in research? By Dr. Yong-Ming He, China

Should doctors be engaged in research?

“Whether clinicians should be engaged in research” is a controversy. However, my viewpoint is clear that clinicians should be engaged in research, clinically or fundamentally. Research is actually a kind of brain’s work. Participation in research shows that clinicians are thinking over patients’ conditions they encounter on daily clinical practice and that they are trying their best to resolve these conditions. Doctors treat and care for patients. Every patient is different. Individualized treatment calls for more doctors who treat patients not only according to guidelines, but also according to every patient’s individual condition. Those doctors who provide individualized treatments must be thinkers. Their treatment and caring-for skills are honed, which will for sure be beneficial to patients, to doctors’ themselves, and ultimately to development of healthcare and medicine. It is unimaginable that clinicians who are reluctant to think will grow up as excellent ones. Research is the thinking hone. Who can afford a lack of this hone to become an excellent doctor?

Research activities are necessarily accompanied by paper writing, which is a process of condensing, precipitating and sorting of our thinking. When you publish your paper in a journal, you raise yourself to a higher level: you’re telling a scientific story to your peers; you’re disseminating your treating and caring-for methods and experience in your academic circles; you’re contributing a fraction of your new knowledge to the medical literature database, which may be carried it on to the next generation.

Which doctors should engage in research?

Which doctors should engage in research? This is an important issue. That every clinician is required to participate in research activities is unnecessary and impractical. Clinicians from primary hospitals, even from municipal-level ones should not be requested to conduct research except that they show much interest in research activity. However, those clinicians from tertiary medical centers in some regions and from university hospitals should actively take the responsibilities to conduct and

participate in various clinical and fundamental researches. The attending doctors and above in these higher level hospitals should be the mainstay of medical research. The clinicians from those tertiary medical centers and university hospitals just focusing on treating and caring for patients are incompetent as production, building-up and dissemination of medical knowledge are primarily dependent on them.

How should doctors be engaged in research?

We should bear in mind that doctors’ major tasks are to treat and care for patients and scientists’ major tasks are to discover the unknown. The fact that we cannot equate doctors with scientists indicates that we have to treat research by doctors and by scientists differently. A Holy Grail of research by clinicians should be like this: do research closest to clinical problems. That means the research should be clinical problem-oriented. Clinical or fundamental research by doctors will produce possible answers to the current clinical problems and even translate into diagnostic capabilities and therapeutic effects. Any clinical problem-based clinical research or fundamental research deserves encouragement and advocate. Any pure fundamental studies by clinicians far away from clinical practice incur discouragement and opposition. Actually, it’s of choice to hand over the pure fundamental research to scientists.

Dr. Yong-Ming He is an interventional cardiologist, Associate Professor in the Division of Cardiology of Soochow University, China. His research interests include epidemiology of cardiovascular diseases, molecular mechanisms of vascular injuries and treatment, and nuclide imaging of coronary artery diseases. His scientific findings include: (I) thallium-201 late SPECT imaging enhances detection of myocardial viability after myocardial infarction; (II) a hypothesis on reverse redistribution in SPECT imaging, e.g., microcirculation dysfunction being the mechanism of the reverse redistribution phenomena. Currently Dr. He has a research team of 5-6 graduate students.

Ms Ling-Yan Ji’s view on clinician’s engagement in research, by Ms Ling-Yan Ji (Katherine), China

When talking about whether Chinese clinicians should engage in research, I think it will be better to be decided by clinicians themselves. However, publications shall not be taken as the only indicator for promotion. The current healthcare promotion system distracts clinicians from their

primary work, the clinical practice, even blinds them, or misguides them.

Research is based on observation, hypnosis and test. It takes time. If research and writing are not coming out of interests to explore new observations or to share the research story, questions and answers, academic fraud prospers. From the perspective of national expenditure, it is a huge waste of time and resource, and even sets the medical field back.

As an editor, I have seen thousands of clinicians suffering from research and discovered that only those who like to explore and share and enjoy research can do research well. This as a return helps them understand clinical problems better.

In a word, whether clinicians should engage in research should be decided by doctors themselves. If yes, it will be the best if it is out of interests, not simply for the promotion needs.

Ms Ling-Yan Ji (Katherine) is an editor at the AME Publishing Company, Guangzhou, China.

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