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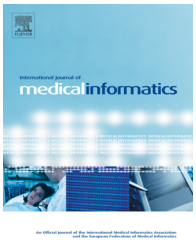

An overview of medical informatics education in China

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ABSTRACT

Objective: To outline the history of medical informatics education in the People's Republic of China, systematically analyze the current status of medical informatics education at different academic levels (bachelor's, master's, and doctoral), and suggest reasonable strategies for the further development of the field in China.

Method: The development of medical informatics education was divided into three stages, defined by changes in the specialty's name. Systematic searches of websites for material related to the specialty of medical informatics were then conducted. For undergraduate education, the websites surveyed included the website of the Ministry of Education of the People's Republic of China (MOE) and those of universities or colleges identified using the baidu.com search engine. For postgraduate education, the websites included China's Graduate Admissions Information Network (CGAIN) and the websites of the universities or their schools or faculties. Specialties were selected on the basis of three criteria: (1) for undergraduate education, the name of specialty or program was *medical informatics* or *medical information* or *information management and information system*; for postgraduate education, *medical informatics* or *medical information*; (2) the specialty was approved and listed by the MOE; (3) the specialty was set up by a medical college or medical university, or a school of medicine of a comprehensive university. The information abstracted from the websites included the year of program approval and listing, the university/college, discipline catalog, discipline, specialty, specialty code, objectives, and main courses.

Results and conclusions: A total of 55 program offerings for undergraduate education, 27 for master's-level education, and 5 for PhD-level education in medical informatics were identified and assessed in China. The results indicate that medical informatics education, a specialty rooted in medical library and information science education in China, has grown significantly in that country over the past 10 years. Frequent changes in the specialty's name and an unclear identity have hampered the visibility of this educational specialty and impeded its development. There is a noticeable imbalance in the distribution of degree programs in medical informatics in different disciplines, with the majority falling under information management. There is also an uneven distribution of the specialty settings of medical informatics at the various academic levels (bachelor's, master's, and doctoral). In addition, the objectives and curriculum design of medical informatics education differ from one university to another and also from those of foreign universities or colleges. It is recommended that China (1) treat medical informatics as a priority "must-have" discipline to build

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in China, (2) establish its own independent, balanced degree programs, (3) set up a specialty of "medical informatics" under the "medicine" category, (4) explore curriculum integration with international medical informatics education, and (5) establish and improve medical informatics education system.

1. Introduction

The development of medical informatics in China is rooted in medical library and information science. Education in this specialty dates back to the early 1960s. At present, there are a growing number of medical universities that offer training programs for librarians in medical informatics. However, formal undergraduate education in health and medical informatics only began in China in the middle 1980s [1].

An increased awareness of the need for health and medical informatics professionals has encouraged universities to develop specialized education programs in medical informatics [2]. In April 1985, *Norman Bethune Medical University* (now *Jilin University*) established the first professional education program in medical library and information science, with the approval of the Ministry of Education (MOE) of the People's Republic of China (PRC) and Ministry of Health (MOH) of the PRC. Thus, the first 4-year medical informatics undergraduate program was formally launched in China. Since then, *Tongji Medical University* (now *Huazhong University of Science & Technology*), *China Medical University*, and *Hunan Medical University* (now *Central South University*) set up similar professional education programs [3,4]. These four universities created the precedent for China's medical informatics education.

Along with changes in the name of the specialty over the years since then, the focus of research in this area has shifted from medical library and information science education to medical information management education [13,14], information management and information system education [15,16], medical information education [17,18], and medical informatics education [19]. Despite their introduction at different times, these various specialty names are being used simultaneously, so that is not always possible to use them to reliably identify a particular program with the past, present, or future stages of medical informatics education in China.

This review is certainly not the first, and is unlikely to be the last reflection on the field. Previous reviews have addressed the education system [5–8], training objectives, modes of education [9], and disciplinary system [10,11] of medical library and information science. Other papers have focused on curriculum systems and core curricula [12].

The purpose of the present analysis is to reflect briefly on the history of China's medical informatics education, systematically analyze the current status of medical informatics education at various academic levels (bachelor's, master's and doctoral), and offer some reasonable strategies for furthering medical informatics education in China.

2. Retrospective of medical informatics education

2.1. Undergraduate education

There have been three significant changes in the name of the specialty since it was established due to China's reform and opening up in 1980s and the new National Ordinary University and College Undergraduate Specialty Directory in 1998. Medical informatics education in China can be classified into the following three stages that reflect these name changes:

2.1.1. The first stage: medical library and information science education (1985–1992)

In 1986, the original National Educational Commission (NEC) of the PRC directed related units to assess the scientific standing and feasibility of the specialty and the discipline. On August 26, 1987, the NEC issued the *National Medical University and College Undergraduate Specialty Directory*. In this directory, the specialty of medical library and information science, termed "library and information science (medicine, pharmacy)," was included under the category of "applied liberal arts, science and engineering." Since then, medical informatics has been formally established as a discipline and specialty [20]. At this point, medical informatics education in the PRC began to enter a rapid stage of development.

2.1.2. The second stage: medical information management education (1992–1997)

During this time period, a wave of name-changing to "information management" swept across the whole of China due to China's reform and opening up in 1980s. In September 1992, "Intelligence" was changed to "Information" in the name of the National Science and Technology and Information Conference, and the Chinese Science and Technology Intelligence Institute was also renamed the Chinese Science and Technology Information Institute by the National Commission of Science & Technology; in October 1992, the Department of Library Science & Information Science of Peking University became the Department of Information Management. At the same time, the specialty of medical library and information science was renamed "information science (medicine, pharmacy)" according to the *National Ordinary University and College Undergraduate Specialty Directory*, which had also been renamed by the original NEC in 1993 [21]. The four original medical universities also used "medical information management" as the name for their core area when forming new educational programs and course systems.

2.1.3. *The third stage: information management and information systems education (1997–present)*

Beginning in April 1997, the original NEC reorganized the *National Ordinary University and College Undergraduate Specialty Directory (1998)* and added a category for management science. The newly added category encompassed five specialties: economic information management, information science, science and technology information, management information systems, and forestry information management. In the revised catalog, the specialty of information management was renamed "information management and information systems." Therefore, information science (medicine, pharmacy) was renamed "information management and information systems (medicine, pharmacy)" [22]. In 1998, the MOE formally approved and directed the four original medical universities to set up an information management and information systems (medicine, pharmacy) program. At the same time, many other universities also set up this specialty. All of them readjusted their educational programs and curriculum in order to adapt to the development of this specialty and discipline.

At the end of 2002, the specialty of information management and information systems (medicine, pharmacy) of *Central South University* was renamed the specialty of "medical informatics," as approved by the MOE [23]. *Nantong University* and *Xuzhou Medical College* also independently established the same specialty in 2008 and 2010, respectively. However, many other universities have not change this specialty's name and still use the term "information management and information systems (medicine, pharmacy)" to recruit undergraduate students to this specialty.

2.2. *Graduate education*

There was neither a discipline nor specialty of information management and information systems in *The Lists of Disciplines and Majors of Master and Doctor Degrees* issued by the MOE in 1997 and revised in 2008. Therefore, graduate education in information management and information systems was mainly completed in other disciplines and majors, such as public management, library, information and file management, clinical medicine, basic medicine, biomedical engineering [24], and, most frequently, library, information and file management.

In recent years, the medical informatics specialty has begun to appear in master's and doctoral education programs as "medical information" in some universities. Generally, the discipline and specialty of medical informatics is authorized by the Office of the State Council Degree of the PRC, and the training program is set up by the university itself.

3. The current situation in medical informatics education in China

3.1. *Undergraduate education in medical informatics*

In order to develop a comprehensive picture of the undergraduate offerings in this specialty, we first drew up a list of specialties at undergraduate universities or colleges, as approved and recorded by the MOE from 2000 to 2010, by scanning the website of the MOE with the baidu.com search engine. The specialty of medical informatics was identified and selected on the basis of three criteria: (1) the name of specialty or subspecialty was medical informatics or medical information, or information management and information systems; (2) the specialty had been approved and listed by the MOE; (3) it had been set up by a medical college or medical university, or a school of medicine of a comprehensive university. The information we abstracted from websites included the year of program approval and listing, university/college name, specialty, specialty code, length of schooling, and discipline category (Table 1).

We then browsed the websites of the universities or colleges and specifically abstracted information about the planned enrollment figure of these universities or colleges in 2011 (Table 1).

Finally, we entered the websites of the schools or faculties and browsed the undergraduate programs of the specialty, extracting information about their objectives and main courses (Table 2).

3.1.1. *Development of specialties within medical informatics*

From Table 1, we can see that, before 2000, there were only four universities that offered a specialty in medical library and information science (now known as information management and information systems, specialty code: 110102 and medical informatics, specialty code: 070408W). At present, there are 55 programs at which the specialty is offered in Chinese universities or colleges. Thus, medical informatics education in China has developed significantly over the past 10 years.

The 55 programs are located in 23 provinces, municipalities, and autonomous regions. Hubei and Shandong province have five each; however, eight provinces (*Chongqing*, *Fujian*, *Guizhou*, *Hainan*, *Hunan*, *Inner Mongolia*, *Jilin*, and *Yunnan*) each have only had one specialty education program. Also, the number of educational institutions with program offerings is still inadequate in regions with a highly developed program of higher education, such as *Beijing* and *Shanghai*. Of the 52 universities or colleges with a specialty of medical informatics, only 3 offer two specialty education programs, e.g. *Hubei University of Traditional Chinese Medicine*, *Liaoning University of Traditional Chinese Medicine*, and *Ningxia Medical University*.

Of the 55 programs, 45 (81.82%) offer information management and information systems (specialty code: 110102); 5 offer medical informatics engineering (specialty code: 080624S): *Sichuan University*, *Hubei University of Traditional Chinese Medicine*, *Liaoning University of Traditional Chinese Medicine*, *Hangzhou Dianzi University*, and *Southern Medical University*. The other five offer medical informatics and related specialties: three of them medical informatics (specialty code: 070408W), one information and computer science (medical informatics) (specialty code: 70102), and one electronic information science and technology (medical information) (specialty code: 71201).

From Table 1, we can also see that the three discipline categories under which these specialties fall are management (45), engineering (5), and science (5). Fourty-nine universities or colleges planned to enroll 2959 new students in 2011, and 3 universities or colleges do not plan to enroll new students; 54

Table 1 – The specialties within medical informatics, as approved and recorded by the MOE (1987–2010).

No	Approved year	Province	University/ college	Specialty code[a]	Length of schooling (years)	Discipline category	Number of students enrolled (2011)
1	1985	Jilin	Jilin University	110102	4	Management	60
2	1985	Liaoning	China Medical University	110102	4	Management	32
3	1986	Hubei	Huazhong University of Science & Technology	110102	4	Management	31
4	1987	Hunan	Central South University	070408W	4	Science	36
5	2000	Henan	Xinxiang Medical University	110102	4	Management	30
6	2000	Jiangsu	China Pharmaceutical University	110102	4	Management	124
7	2000	Zhejiang	Wenzhou Medical College	110102	4	Management	58
8	2001	Anhui	Anhui University of Traditional Chinese Medicine	110102	4	Management	60
9	2001	Guangdong	Guangdong Medical College	110102	4	Management	72
10	2001	Guangxi	Guangxi Medical University	110102	4	Management	50
11	2001	Hebei	Hubei United University	110102	4	Management	62
12	2001	Hebei	Zhangjiakou Medical college	110102	5	Management	70
13	2001	Hubei	Hubei University of Traditional	110102	4	Management	60
14	2005		Chinese Medicine	080624S	4	Engineering	120
15	2001	Shandong	Binzhou Medical University	110102	4	Management	65
16	2001	Chongqing	Chongqing Medical University	110102	4	Management	40
17	2002	Anhui	Wannan Medical College	110102	4	Management	120
18	2002	Guangdong	Guangdong Pharmaceutical University	110102	4	Management	62
19	2002	Guizhou	Zunyi Medical College	70102	4	Science	50
20	2002	Shandong	Taishan Medical University	110102	4	Management	100
21	2002	Shandong	Jining Medical University	110102	4	Management	60
22	2002	Shanxi	Shanxi Medical University	110102	4	Management	65
23	2002	Shanxi	Changzhi Medical College	110102	4	Management	40
24	2003	Heilongjiang	Harbin Medical University	110102	4	Management	50
25	2003	Jiangsu	Nanjing University of Chinese Medicine	110102	4	Management	74
26	2003	Inner Mongolia	Inner Mongolia Medical College	110102	4	Management	80
27	2003	Sichuan	Sichuan University	080624S	4	Engineering	54
28	2003	Xinjiang	Xinjiang Medical University	110102	4	Management	36
29	2004	Guangdong	Southern Medical University	80607	4	Engineering	46
30	2004	Hebei	JItang college of Hubei United University	110102	4	Management	–
31	2004	Henan	Henan University of Traditional Chinese Medicine	110102	4	Management	160
32	2004	Hubei	Hubei University of Medicine	110102	4	Management	45
33	2004	Sichuan	Luzhou Medical College	110102	4	Management	–
34	2005	Shandong	Shandong University of Traditional Chinese Medicine	110102	4	Management	60
35	2006	Guangxi	Guangxi Traditional Chinese Medical University	110102	4	Management	30
36	2006	Heilongjiang	Mudanjian Medical University	110102	4	Management	40
37	2007	Anhui	Bengbu Medical College	110102	4	Management	60
38	2007	Hubei	Wuhan Bioengineering institute	110102	4	Management	60
39	2007	Jiangsu	Nantong University	070408W	4	Science	35
40	2007	Ningxia	Ningxia Medical University	110102	4	Management	–

– Table 1 (Continued)

No	Approved year	Province	University/college	Specialty code[a]	Length of schooling (years)	Discipline category	Number of students enrolled (2011)
41				71201	4	Science	40
42	2007	Xinjiang	Houbo College of Xinjiang Medical University	110102	4	Management	–
43	2008	Hainan	Hainan Medical College	110102	4	Management	60
44	2008	Sichuan	Chengdu Medical College	110102	4	Management	50
45	2008	Yunnan	Haiyuan College of Kumming Medical University	110102	4	Management	55
46	2009	Fujian	Fujian University of Traditional Chinese Medicine	110102	4	Management	60
47	2009	Heilongjiang	Qiqihar Medical University	110102	4	Management	30
48	2009	Shandong	Shandong Wanjie Medical College	110102	4	Management	62
49	2009	Liaoning	Liaoning University of Traditional Chinese Medicine	110102	4	Management	30
50	2010			080624S	4	Engineering	30
51	2010	Anhui	Anhui Medical University	110102	5	Management	60
52	2010	Guangdong	Guangzhou Medical University	110102	4	Management	60
53	2010	Jiangsu	Xuzhou Medical College	070408W	4	Science	40
54	2010	Shanxi	Shanxi University of Traditional Chinese Medicine	110102	4	Management	50
55	2010	Zhejiang	Hangzhou Dianzi University	080624S	4	Engineering	35

[a] 110102: information management and information systems, 70102: information and computer science (medical informatics), 080624S: medical informatics engineering, 070408W: medical informatics, and 71201: electronic information science and technology (medical information).

(98.82%) provide 4 years of schooling, and only one provides 5 years of schooling.

3.1.2. *The objectives of undergraduate education*

The overall objective of this undergraduate education is to equip students with specialized knowledge in the field of medical informatics and the skill to apply the acquired knowledge in a variety of practical medical information situations. The intention is to provide a deep understanding of the state-of-the-art of this discipline and the ability to translate expertise gained in the field into practical application. However, the specific objectives vary with the name of the specialty and the nature of the university or college.

First, for the specialty of information management and information systems (specialty code: 110102), taking *Huazhong University of Science & Technology* as an example, the objective is to produce a specialized informatician of high quality in the field of medical information management who can adapt to the needs of modern information management in China. This kind of quality will guarantee that, after graduation, students will be able to be profitably engaged in medical information management, information service, information analysis and research, or hospital database management and will have the proper foundation to carry on lifelong learning and advanced studies in medical information management [25]. Of course, every medical college and university has its own characteristics, and its objective is slightly different. For example, at *Liaoning University of Traditional Chinese Medicine*, the objective of the specialty is directed more toward the field of traditional Chinese medicine, as it is at the *Anhui University of Traditional Chinese Medicine*, *Fujian University of Traditional Chinese Medicine*, *Henan University of Traditional Chinese Medicine*, *Hubei University of Traditional Chinese Medicine*. However, for *China Pharmaceutical University and Guangdong Pharmaceutical University*, the objectives of the specialty are more inclined toward the field of pharmacy.

Second, for the specialty of medical informatics (specialty code: 070408W), taking Central South University as an example, the objective is to equip students with knowledge of medicine, modern management theory, and information science and the skills and ability to apply computer science and technology and to become an application-oriented, complex high-level medical informatician.

Third, for the specialty of medical informatics engineering (specialty code: 080624S), the objective is to equip students with the background in biology or pharmaceutics, management, and information technical skills that is necessary for the design, development, and application of integrated electronic devices; with basic knowledge of and practical skills in information engineering in the field of health and hospital activities; and with the ability to work professionally in one or more of the following areas: biomedical electronics, medical instrumentation, medical imaging, medical signal processing, and hospital management.

3.1.3. *Main courses for undergraduate education*

A total of 805 main courses were identified from the websites of 48 universities or colleges in 51 programs. The 805 main courses could be divided into six categories: medicine, mathematics/statistics, management, information science,

Table 2 – Disciplines of the main courses in universities or colleges (N = 51).

University/college	Specialty code	Medicine	Mathematics/ statistics	Management	Information science	Computer science	Economics	Total	Focus on
Anhui Medical University	110102	2	2	2	4	7	2	19	Computer Science
Anhui University of Traditional Chinese Medicine	110102	1	2	1	5	3	1	13	Information Science
Bengbu Medical College	110102	3	1	3	3	5	–	15	Computer Science
Binzhou Medical University	110102	2	1	2	7	4	1	17	Information Science
Chengdu Medical College	110102	2	–	1	4	5	1	13	Computer Science
Fujian University of Traditional Chinese Medicine	110102	6	6	4	4	10	2	32	Computer Science
Guangdong Pharmaceutical University	110102	–	2	1	5	4	1	13	Information Science
Guangdong Medical College	110102	3	1	2	4	3	–	13	Information Science
Guangxi Medical University	110102	–	–	1	7	9	–	17	Computer Science
Guangxi Traditional Chinese Medical University	110102	2	1	1	3	4	–	11	Computer Science
Guangzhou Medical University	110102	–	1	3	1	5	3	13	Computer Science
Harbin Medical University	110102	3	2	–	1	12	–	18	Computer Science
Hainan Medical College	110102	–	3	2	1	11	–	17	Computer Science
Hangzhou Dianzi University	080624s	5	–	–	7	12	–	24	Computer Science
Hubei United University	110102	–	2	1	4	5	2	14	Computer Science
Henan University of Traditional Chinese Medicine	110102	1	–	1	5	2	–	9	Information Science
Hubei University of Medicine	110102	2	–	2	1	5	–	10	Computer Science
Hubei University of Traditional Chinese Medicine	110102	1	2	1	3	7	1	15	Computer Science
	080624s	2	3	1	5	14	–	25	Computer Science
Huazhong University of Science & Technology	110102	4	–	–	6	2	–	12	Information Science
Jilin University	110102	2	–	1	7	2	–	12	Information Science
Jining Medical University	110102	5	–	–	5	2	–	12	Information Science
Haiyuan College of Kumming Medical University	110102	2	1	2	2	5	–	12	Computer Science
Liaoning University of Traditional Chinese Medicine	110102	6	4	1	6	5	–	22	Information Science
	080624s	4	3	–	8	10	–	25	Computer Science
Mudanjian Medical University	110102	1	–	1	2	6	–	10	Computer Science
Southern Medical University	80607	2	1		8	5	–	16	Computer Science
Nanjing university of Chinese Medicine	110102	2	–	2	5	4	1	14	Information Science
Nantong University	070408W	2	2	–	4	6		14	Computer Science
Inner Mongolia Medical College	110102	11	–	–	1	3	–	15	Medicine
Ningxia Medical University	71201	–	2	–	3	15	–	20	Computer Science
Qiqihar Medical University	110102	7	–	1	6	3	–	17	Medicine
Shandong Wanjie Medical College	110102	–	–	4	2	2	–	8	Management
Shandong University of Traditional Chinese Medicine	110102	4	1	3	5	2	3	18	Information Science
Shanxi Medical University	110102	2	2	2	3	4	1	14	Computer Science
Shanxi University of Traditional Chinese Medicine	110102	10	–	–	2	4	–	16	Medicine

Table 2 – Table 2 (Continued)

University/college	Specialty code	Medicine	Mathematics/ statistics	Management	Information science	Computer science	Economics	Total	Focus on
Sichuan University	080624s	1	–	–	5	13	–	19	Computer Science
Taishan Medical University	110102	–	1	1	3	4	4	13	Economics
Wannan Medical College	110102	–	–	1	2	6	–	9	Computer Science
Wenzhou Medical College	110102	2	1	3	4	4	1	15	Computer Science
Wuhan Bioengineering Institute	110102	–	1	1	4	5	5	16	Economics
Xinjiang Medical University	110102	2	1	2	2	10	3	20	Computer Science
	110102	–	–	–	6	3	1	10	Information Science
Xuzhou Medical College	070408W	6	4	2	4	7	1	24	Computer Science
Zhangjiakou Medical College	110102	2	–	1	2	7	–	12	Computer Science
Changzhi Medical College	110102	2	2	2	5	3	3	17	Information Science
China Pharmaceutical University	110102	5	4	–	5	5	–	19	Information Science
China Medical University	110102	1	–	1	9	4	–	15	Information Science
Central South University	070408W	6	1	–	7	3	–	17	Information Science
Chongqing Medical University	110102	4	2	–	8	5	1	20	Information Science
Zunyi Medical College	70102	3	2	1	2	6	–	14	Computer Science
Total courses		133	64	61	217	292	38	805	–
Number of programs (N = 51)		40	32	36	51	51	20	–	–
% (N = 51)		78.43	62.75	70.59	100	100	39.22	–	–

– indicates no main course in this discipline.

computer science, economics based primarily on the course titles and descriptions (Table 2).

As Table 2 shows, *Fujian University of Traditional Chinese Medicine* offered 32 main courses, the largest number among the 48 universities or colleges in 51 programs. The number of courses ranged from 8 to 32, with a mean of 15.8 (805/51) courses. *Shandong Wanjie Medical College*, *Henan University of Traditional Chinese Medicine*, and *Wannan Medical College* offered only 8, 9, and 9 courses, respectively.

In terms of discipline, there were much greater differences among the 51 programs: Of the 805 courses, the largest numbers were in information science and computer science (217 and 292, respectively). All 51 programs had at least one course in information science and computer science. However, only 20 (39.22%) of programs had one course in economics.

Table 2 indicates that most universities or colleges have focused mainly on computer science, with many courses in this field. However, some universities or colleges have focused on information science. Particular emphases are given to medicine, economics, or management in a few universities or colleges.

3.2. *Master's level education in medical informatics*

We first searched the catalog of master specialties in the *China's Graduate Admissions Information Network* (*CGAIN*) (http://yz.chsi.com.cn/), which was founded by the Division of College Students of the MOE in 1999. The CGAIN is an authorized platform designed not only for online registration of postgraduate entrance exams and online transfers but also for graduate admission publicity, recruitment consultation, registration management, and student exchanges. In order to access all the information, different names of specialties were searched, including information science, informatics, medical informatics, health information management, and medical information management.

We then entered the websites of the universities, colleges, or graduate schools of the universities to browse the latest specialty directories of graduate admission. We specifically retrieved the following information about the specialties: year of authorization, university/college name, discipline category, discipline, specialty, and specialty code (see Table 3), research directions, and entrance examination subjects (see Table 4).

Finally, we entered the websites of the schools or faculties and browsed the postgraduate programs in the specialty, and then specifically retrieved the relevant major courses and electives (see Table 5).

3.2.1. *Discipline and specialty of medical informatics*

In China, 27 authorized degree program and 21 universities/colleges were involved in master's degree education in medical informatics from 1984 to 2010 (Table 3); 20 were in management in this discipline category. Medicine and engineering were represented by 3 each and science by only one. The duration of the master is 2–4 years.

Thirteen degree programs were in library, information and file management, 7 in public management, 3 in biomedical engineering, and 2 in clinical medicine; basic medicine and biology had one each.

Table 3 – Disciplines and specialties in medical informatics at the master's degree level in Chinese universities or Colleges.

University/college	Specialty	Specialty code	Authorized year	Discipline category	Discipline
China Academy of Chinese Medical Sciences	Information Science	120502	1984	Management	Library, Information and File Management
Peking Union Medical College	Information Science	120502	1988	Management	Library, Information and File Management
Academy of Military Medical Science	Information Science	120502	1992	Management	Library, Information and File Management
Central South University	Information Science	120502	1996	Management	Library, Information and File Management
	Library Science	120501	2006	Management	Library, Information and File Management
Jilin University	Social Medicine and Health Management	120402	2000	Management	Public Management
Weifang Medical University	Social Medicine and Health Management	120402	2000	Management	Public Management
The Second Military Medical University	Information Science	120502	2000	Management	Library, Information and File Management
Nanjing Medical University	Social Medicine and Health Management	120402	2001	Management	Public Management
Hebei United University	Social Medicine and Health Management	120402	2001	Management	Public Management
Chongqing Medical University	Social Medicine and Health Management	120402	2002	Management	Public Management
Lanzhou University	Social Medicine and Health Management	120402	2003	Management	Public Management
Xinjiang Medical University	Social Medicine and Health Management	120402	2003	Management	Public Management
	Information Science	120502	2006	Management	Library, Information and File Management
The Fourth Military Medical University	Library Science	120501	2003	Management	Library, Information and File Management
	Information Science	120502	2003	Management	Library, Information and File Management
Fudan University	Library Science	120501	2003	Management	Library, Information and File Management
	Medical Informatics	100121[a]	2004	Medicine	Basic Medicine
Sichuan University	Medical Information Engineering	083120[a]	2004	Engineering	Biomedical Engineering
	Medical Informatics	100227[a]	2006	Medicine	Clinical Medicine

Table 3 – Table 3 (*Continued*)

University/college	Specialty	Specialty code	Authorized year	Discipline category	Discipline
Huazhong University of Science & Technology	Information Science	120502	2005	Management	Library, Information and File Management
Southeast University	Medical Information Engineering	083100[a]	2006	Engineering	Biomedical Engineering
China Medical University	Information Science	120502	2006	Management	Library, Information and File Management
Shandong Academy of Medical Sciences	Information Science	120502	2006	Management	Library, Information and File Management
Chinese Academy of Sciences	Biological Information Science	071024	2009	Science	Biology
Nantong University	Biomedical Engineering	083100[a]	2010	Engineering	Biomedical Engineering
	Biomedical Engineering	107200[a]	2010	Medicine	Clinical Medicine

[a] The specialty is established by the university itself and authorized by the MOE.

Ten authorized were in information science, 7 in social medicine and health management, 3 in library science, 2 each in biomedical engineering, medical informatics and medical information engineering, one in biological information science.

These numbers not only show that medical informatics education is developing rapidly in China and that its future is bright but also that medical informatics is still perceived as a diffused science, a tool for the health and medical sciences, rather than a science in its own right. Because it lacks its own discipline category and system of specialties, the development of medical informatics education still tends to be somewhat disordered and disorganized.

3.2.2. *Research directions and entrance examination subjects*

In terms of research directions, some research programs are broader, and some are more circumscribed and detailed. As is shown in Table 4, there are 68 research directions among the 27 authorized degree programs. They can be grouped into 10 categories: basic theoretical research in medical informatics, digital library research, information management, medical and health information service, hospital information systems, medical image processing, recognition and transmission, medical editing and publishing, development and utilization of information resources, medical informatics and engineering, and medical information technology.

Four subjects are covered in the unified national graduate entrance examination: the first is politics and the second English. These two subjects are uniformly addressed by all universities or colleges. The third and the fourth subjects are generally major subjects and differ among the various universities or colleges. Two trends can be seen in the list of major subjects shown in Table 4: one is more particularly to test basic knowledge of library and information science and to ask students to demonstrate comprehensive knowledge in areas such as general information science and general information management; the other is to allow students to choose from multiple subject options. For example, the fourth subject in medical information engineering at Sichuan University includes three options: electronic module technology, biomedical engineering, and physiology.

3.2.3. *The objectives of master's degree education*

Medical informatics education straddles many health and medical disciplines, as described above. Therefore, variation in objectives is commonly observed even within the same university. For example, *Fudan University*, one of China's foremost institutions of advanced learning and higher education, has achieved worldwide acclaim and has undoubtedly been one of the leading universities in developing and promoting Chinese medical informatics education in recent years; this university has two completely different academic departments to promote medical informatics education, the *Documentation and Information Center* and *Shanghai Medical College*. Furthermore, the objectives of medical informatics education in the two departments are completely different, with one focused on medical documentation and information and the other on basic clinical information and data and image processing.

Table 4 – Research directions and entrance examination subjects in medical informatics.

University/college	Specialty	Research directions	Entrance examination subjects (major)[a]
China Academy of Chinese Medical Sciences	Information Science	01Traditional Chinese Medicine (TCM) Informatics; 02TCM Control Strategy for Cardiovascular Diseases; 03Analysis and Research of TCM Information; 04Bibliology and Version of TCM Literatures	(3)Information Management or Basic Theory of TCM; (4)Information Retrieval of TCM
Peking Union Medical College	Information Science	01Information Science	(3)Introduction to Information Science; (4)Medical Informatics
Academy of Military Medical Science	Information Science	01Publishing of Science and Technology of Medicine; 02Biomedical Information; 03Medical Information; 04Medical and Health Information Service	(3)Genera biology or Genera Information Science; (4)Molecular Biology or Introduction to Information Science
		01Organization and utilizing of Medical Information; 02Organization and Construction of Medical Information Resources; 03Medical Information Network; 04Research and Using of Medical Information	(3)Mathematics II or Genera Information Science; (4)Introduction to Information Science or Application of Computer Science
Central South University	Information Science	01Information Resources Management; 02Information Retrieval; 03Information Research and Consulting; 04Hospital Information System;05Intellectual Property	(3)Information Resources Management; (4) Basic Application of Computer Science
	Library Science	01Research and Application of Electronic Medical Records; 02Telemedicine; 03Ultrasound Image Processing, Recognition and Transmission; 04Radiation Image Processing, Recognition and Transmission	(3)General Medicine; (4)Medical Informatics
Jilin University	Social Medicine and Health Management	01Medical Editing and Publishing; 02Compilation and Publication of Medical Books	(3)Health Management; (4)Editorial Science

Table 4 – Table 4 (*Continued*)

University/college	Specialty	Research directions	Entrance examination subjects (major)[a]
Weifang Medical University	Social Medicine and Health Management	01Health Information Management; 02Health Information Technology and its Applications	(3)General Medicine or Preventive Medicine; (4)General Health Management
The Second Military Medical University	Information Science	01Standardization of Health Information and Community Health Services Research	(3)General Health Management; (4)Fundamentals of Management
Nanjing Medical University	Social Medicine and Health Management	01Medical Information Management	(3)Fundamentals of Management; (4)Database Technology
Hebei United University	Social Medicine and Health Management	01Health Information Management	(3)General health management; (4)Epidemiology
Chongqing Medical University	Social Medicine and Health Management	01Information Analysis and Health Information Technology; 02Health Care Information Management	(3)General Management; (4) Principles of Management
Lanzhou University	Social Medicine and Health Management	01Information Organization and Communication	(3)General Information management; (4)Introduction of Information Science
Xinjiang Medical University	Social Medicine and Health Management	01Medical and Health Information Management	(3)General Public Health or General Health Management
The Fourth Military Medical University	Library Science	01Hospital Information System and Information Management	(3)General health management; (4)Fundamentals of Management
	Information Science	01Construction and Management of Information System	(3)General Information management; (4)Introduction of Library Science
Fudan University	Library Science	01Management and Utilization of Social Science Literature; 02Digital Library Research; 03Information Service; 04Aancient Books Protection	(3)Bibliography; (4)Library Science
	Medical Informatics	01Development and Utilization of Information Resources; 02Editorial Science of Sci-tech Periodicals	(3)General Information Science; (4)Introduction to Information Management
Sichuan University	Medical Information Engineering	01Medical Electronics; 02Medical Signal and Image Processing; 03Medical Equipment; 04Medical Information Systems	(3)Mathematics I; (4) Electronic Module Technology or Biomedical Engineering or physiology
	Medical Informatics	01Text Mining and Knowledge Discovery; 02Bibliometrics; 03Information Management	(3)Mathematics III or General Information Management; (4)Basic Application of Computer Science or Introduction to Information Science

Table 4 – Table 4 (*Continued*)

University/college	Specialty	Research directions	Entrance examination subjects (major)[a]
Huazhong University of Science & Technology	Information Science	01Digital Library Technology and Management; 02Health Management Information System; 03Medical Information Management	(3)Information Management Theory; (4) Information Analysis and Forecasting
Southeast University	Medical Informatics and Engineering	01Medical Information Research and Health Policy Consulting; 02Sci-Tech Information Management and Evaluation; 03Hospital Medical Information analysis and Information Management; 04Information Resource Development and Management of Medical Knowledge	(3)Mathematics III or Health Statistics; (4)Introduction to Information Science
China Medical University	Information Science	01Library Science Theory; 02Digital Library Research; 03User Research and Information Services; 04Library Management	(3)General Information Resource Management; (4)Basic Application of Computer Science
Xinxiang Medical University	Information Science	01Computer-aided Diagnosis and Treatment; 02Study of Human Morphology Database; 03Tumor Tissue Pathology Information Research; 04Computer-aided Bone Tissue Engineering Design	(3)General Medicine
Shandong Academy of Medical Sciences	Information Science	01Hospital Information Management and Applications;02Clinical Information System and Electronic Medical Records	(3)Mathematics I; (4)Organic Chemistry or Biological Signal Processing or General Biology
Chinese Academy of Sciences	Biological Information Science	01Strategic and Discipline Information; 02Research and Analysis of Biological Information Technology and Sources of Information	(3)Mathematics III or Introduction to Information Science; (4)Sci-Tec Information Retrieval
Nantong University	Biomedical Engineering	01Medical Informatics and Engineering (083100[b])	(3)Mathematics I; (4)Data Structures
	Biomedical Engineering	01Medical Informatics and Engineering (107200[b])	(3)General Medicine

[a] (1) politics; (2) English; (3) and (4) major subjects as shown.
[b] The specialty is established by the university itself and authorized by the MOE.

Table 5 – Main courses offered in master's degree programs at seven universities.

Universities	Discipline	Major fundamental courses	Discipline-oriented elective courses
Central South University	Library, Information and File Management	Theory and methods of Library and information science, Information resource management, Knowledge organization research, Theory and practice of modern information retrieval, Information research and consulting, Intellectual property research, Digital libraries, Library management, Progress in hospital information technology	Information systems development and design, Topics on information dissemination, Principles and methods of bioinformatics, SPSS and its applications in medicine, Medical statistics, Medical intelligence
Huazhong University of Science & Technology	Library, Information and File Management	Theory and methods of information science, Research methods of soft science, Management information systems, Medical information analysis, Medical information science, Introduction to information methods, Professional foreign language	Data mining and strategic management, Medical e-commerce, Knowledge management, SPSS, Advances in bioinformatics technology, Contemporary management, Program design
Jilin University	Social Medicine and Health Management	Advanced public health, Medical statistics, Social medicine, Health management, Medical informatics, Health law	Java program design, Scientific metrology and evaluation, Medical information resource organizations, Progress in medical information retrieval, Information sociology, Theory and methods of digital libraries, Computer multimedia technology, Information resources of evidence-based medicine, Intellectual property research, Information needs and retrieval, Writing
Fudan University	Library Science	Java program design, Introduction to classical literature, Information system technology and management, Modern library science, Electronic literature search, Advanced database, Distributed databases, Digital libraries, Information consulting and information services, Library services practice	Advanced networks, Advanced software engineering, Information retrieval, Graphics and visualization
	Medical Informatics	Image processing and interpretation, Calculation methods, Digital signal processing, Modern histo-chemical, Functional anatomy, Bio-image processing and analysis technology, Biomedical electronics, Medical imaging technology and new theories, Medical statistics, Progress in biomedical engineering JAVA program design, Introduction to medical informatics, Pattern recognition, Computer graphics and visualization	Medical information retrieval and utilization, progress in basic medicine, Writing and publication of research paper, Advanced physiology, Medical imaging, Random signal analysis, Advanced algorithms and computational complexity, Stochastic processes, Numerical analysis, Harmonic analysis and wavelet analysis, Advanced theory and technology of medical photography, Network and Internet, Developmental neurobiology, Theory and practice in pathology
Southeast University	Biomedical Engineering	Bioelectronics, Biomaterials, Analysis and Processing of multi-dimensional signals, Biomedical Statistics, Numerical analysis	Chemical biology, Bio-sensing and bio-analysis, Introduction to nano-science and technology, Bioinformatics, Principles and practice of medical imaging, Information visualization techniques, Advanced medical instruments
Xinxiang Medical University	Information Science	Information storage and retrieval, information communication, theory and practice of modern intelligence, information analysis and prediction, data mining	Medical linguistics, Health law, Humanities and social medicine, Health economics, Knowledge organization and management, Medical records management, Advances in hospital information management, Competitive intelligence, Information management system
Shandong Academy of Medical Sciences	Information Science	Basic applications of computer in medicine, Medical statistics, Medical literature retrieval, Clinical epidemiology, research design and writing, Frontier in medical informatics, Bibliometrics, Design and analysis of information science research, Case studies of intelligence investigation, Professional English	Principles and applications of database system, Network (Web site) management and maintenance, Program development and application, Health information management, Competitive intelligence

The objectives of the master's degree programs can be divided into three main categories: the first is medical informatics education in the field of management, including library, information and file management and public management. The objective here is to equip students with specialized knowledge in the field of medical library, information and file management and the skills necessary to apply the acquired knowledge in a variety of practical medical documentation and information settings.

The second category is medical informatics education in the field of engineering, and principally biomedical engineering. The objective of these programs is to give students a broad and solid theoretical foundation in the fields of biomedical engineering and help them to systematically develop the relevant subject area expertise, become specialists in the experimental techniques used in their research areas, and develop the ability to conduct independent scientific research across the wider fields of science, engineering, and medicine. Once they have completed their training, the students will be capable of doing scientific research, fostering technological development, and teaching.

The third category is medical informatics education in the field of medicine. The objective here is to provide a scientific education that covers the theoretical foundations of the field of medicine, including basic medicine (i.e., human anatomy, pathology, molecular biology, neurobiology, and so forth) and clinical medicine (including neurosurgery, medical imaging, nuclear medicine, and clinical diagnosis), provides specialized knowledge of medical informatics, and equips students with both the practical skills and analytical approaches they need to further the knowledge base of the discipline. Graduates of these programs will not only be able to master practical methods and tools but also become leaders in independent research.

3.2.4. *Main courses in the master's degree programs*

The main courses in the medical informatics master's degree programs at seven universities were retrieved from their websites (Table 5). The curriculum in these schools is composed of two components: the major fundamental courses and discipline-oriented elective courses. In the vast majority of universities or colleges, the emphasis of the major fundamental courses is on management-oriented medical information, but in a few universities, it is on patient-oriented medical information. These courses provide students with a state-of-the-art knowledge of the profession: the latest theories, methods, and techniques.

A large number of discipline-oriented elective courses are offered in each university. These courses provide students with the skills necessary to apply the relevant methods and techniques to scientific research, and they further address the students' gaps in knowledge and provide practical training in particular medical informatics domains.

3.3. *PhD education in medical informatics*

We were very pleased to see that PhD education in medical informatics is on the rise in China. We found this specialty to be independently set up by each university, often in the discipline category of medicine (for example, at Fudan *University*, *Sichuan University*, and *Chongqing Medical University*). In addition, other universities have also set up medical informatics-related research directions in other specialties and disciplines (for example, *Jilin University*'s Social Medicine and Health Management and *Southeast University*'s Biomedical Engineering; see Table 6).

However, no medical universities or colleges or school of medicine of comprehensive universities have been authorized to set up PhD education programs in library and information science in the medicine field, and this omission has undoubtedly hindered the further development of the subdiscipline.

4. Recommended strategies for medical informatics education

4.1. *The identity of medical informatics*

Medical informatics in China has its roots on medical library and information science and has focused on approaches for systematically processing literature, information, and knowledge in medical libraries and medical information institutes. Therefore, the objectives of medical informatics education in China tend to focus more on equipping students with specialized knowledge in the field of medical library and information science and the skills needed to apply their acquired knowledge in a variety of practical medical literature- and information-related situations. Curriculum design and teaching practice tend to focus on the processing of medical literature, a very different focus from that of the American medical informatics education, which is more highly focused on the machine processing of data, information, and knowledge in health care and medicine. Different levels of medical informatics education in the US (bachelor's, master's, and doctoral) have different education needs related to the differing experience, professional roles, and responsibilities associated with these different levels of education [26].

However, medical informatics is not yet a clearly established, independent discipline in China. Thus far, it seems to have been considered a "nice-to-have" (but not "need-to-have") discipline, a perception that is underscored by the frequent changes in the specialty's name. Even now, it might be termed an "orchid discipline" – just a nice orchid in the garden of the science [27]. In China, medical informatics is still perceived as a tool for the health and medical sciences, rather than a science in its own right. The frequent changes in the specialty's name and the unclear identity of its discipline have made medical informatics education appear unfocused and disorganized and have hampered its development.

Therefore, it is necessary for medical informatics in China to be treated as a vigorous young discipline, a new interdisciplinary, "must-have" discipline, and the overlapping disciplines closely related to the core field of medical informatics, such as biomedical engineering, medical library and information sciences, information management and information system, and molecular biology, need to be integrated into a coherent, easily recognizable field.

Table 6 – Disciplines and specialties in medical informatics at the PhD level in Chinese universities and colleges.[a]

Authorized year	University	College	Discipline category	Discipline	Specialty	Specialty code	Research directions
2003	Chongqing Medical University	Faculty of Information Management	Medicine	Biomedical Engineering	Biomedical Information Technology	**107223**[b]	01Study on cerebral vascular disease by neuroimaging; 02Tumor occurrence & development of microRNA target gene regulation mechanisms; 03Image Processing
2004	Fudan University	Shanghai Medical College	Medicine	Basic Medicine	Medical Informatics	100121[b]	01Computer-aided diagnosis and treatment; 02Study on of human shape database; 03Study on tumor pathology information
2006	Sichuan University	West China School of Medicine	Medicine	Clinical Medicine	Medical Informatics	100227[b]	01Hospital Information Management System; 02Research and application of electronic medical records and clinical information systems; 03Research and application of laboratory information systems; 04Medical informatics in the application of otorhinolaryngology; 05Ultrasound image processing, recognition and transmission; 06Radiation image processing, recognition and transmission; 07Medical information in the application of Neurology; 08 Clinical Data Mining; 09 Computer applications in medicine
2006	Jilin University	School of Public Health	Management	Public Management	Social Medicine and Health Management	120402	01 Health information resources and management; 02 Health information technology and management
2006	Southeast University	School of Biological Science & Medical Engineering	Engineering	Biomedical Engineering	Biomedical Engineering	83100	01Hospital information management and application; 02Clinical information systems and electronic medical records

[a] Data from the latest training program of PhD collected from website of every university by author.
[b] The specialty is established by the university itself and authorized by the MOE.

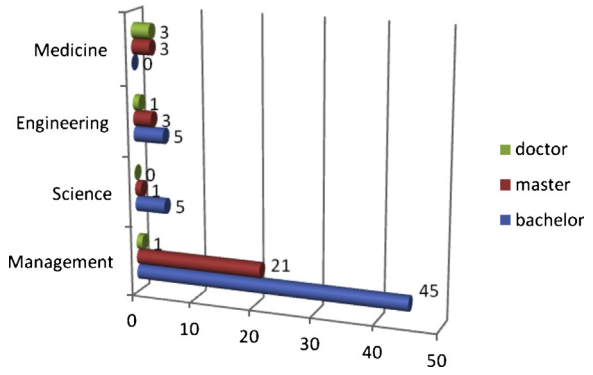

Fig. 1 – The distribution of degree programs in medical informatics in China.

4.2. *Development of degree programs in medical informatics*

Degree programs are important undergirding elements of academic disciplines, and their quantity and quality are not only important indicators of the level of a discipline but also of the importance of sophisticated and advanced academic performance as part of a university or college education. Degree programs in medical informatics in China have focused on the bachelor's level; this narrow focus at the entry level has not only hindered the development of scientific research in this area but has also not fostered innovation in this area of higher education. In addition, the distribution of degree programs in medical informatics is quite imbalanced in terms of the disciplines involved (see Fig. 1). Therefore, it is necessary that China establish its own independent, balanced degree programs to address the growing need for training and qualified graduates in medical informatics.

In addition, China should actively seek to establish independent, authorized programs at the master's degree and doctoral levels and should strive to develop a more interdisciplinary approach to medical informatics education. Furthermore, this country needs to support the existing authorized programs related to medical informatics, such as master's degree programs in information science and doctoral programs in social medicine and health management and so on.

Domestic experts and scholars in related fields need to understand the importance and necessity of medical informatics education to promote the development of degree programs in China. At the same time, those involved in Chinese medical informatics education should become involved in the International Medical Informatics Association (IMIA) [28,29], the International Partnership for Health Informatics Education (IPHIE), [30] and the Asia Pacific Association for Medical Informatics (APAMI) [31] and share their experiences and lessons learned in order to help promote and further develop medical informatics education in China.

4.3. *Specialty settings of medical informatics*

There is currently a lack of uniformity between the specialty settings with which medical informatics is associated in the *National Ordinary University and College Undergraduate Specialty Directory (2011)* and the *Degree Awarded and Talent Training Disciplines Directory (2011)*. Only the specialty setting of medical informatics shows a pyramid shape at the three different levels (bachelor's, master's and doctoral), with five, two, and two programs, respectively (Fig. 2). Other specialty settings are incomplete, with some having no undergraduate education (for example, information science, library science, social medicine and health management) and some having no PhD programs (for example, medical information engineering, information science, and library science). We were surprised to find that many universities or colleges had set up an undergraduate education program in information management and information systems, but none had sets up a master's degree or PhD program (Fig. 2). These glaring omissions in informatics education completely undermine the continuity of training for would-be students.

Thus, integration of medical informatics education and expansion of the missing educational programs must become a top priority for the development of the entire field.

Some scholars believe that it would be advantageous for training in medical informatics if the specialty of information management and information systems were incorporated into the specialty of "social medicine and health management";

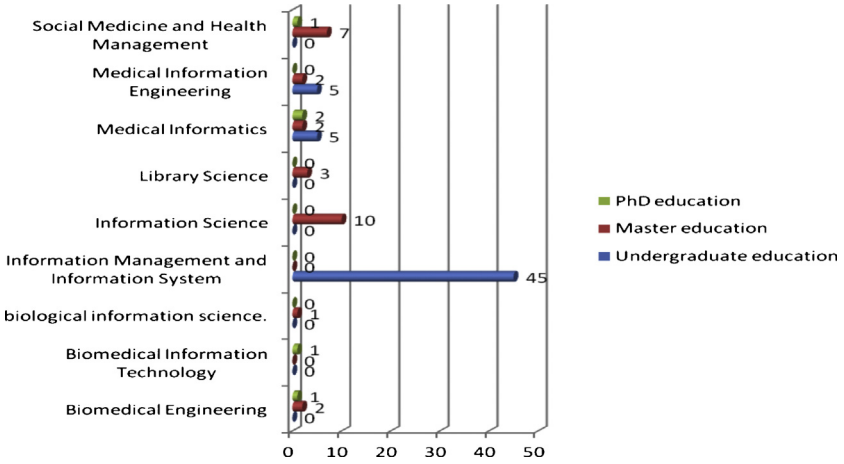

Fig. 2 – Specialty settings of medical informatics.

to date, medical informatics has not been formally included in the National Specialty Directory [32]. However, given that social medicine and health management has its own specific definition, this category would not be the best choice for medical informatics and related specialties (such as information management and information systems, medical information engineering).

In our opinion, it would be much more appropriate to set up a "medical informatics" specialty under the "medicine" category. Then, information management and information systems (medicine), medical information science, medical library science, medical information systems, medical information engineering, and medical information statistics would form an independent specialty system.

Toward this end, China should establish a National Guidance Committee for Medical Informatics Education, whose aims would be to establish the basic requirements and conditions for medical informatics education, such as discipline construction, specialty standards, teaching quality criteria, core courses, and experimental research training. Furthermore, in order to promote the comprehensive development of medical informatics education, those in the field should recruit a number of top-ranked universities in terms of academic standing, scientific research, and professional development from all over the country in order to establish a provincial, and even national, academic base that will be able to pool its resources to strengthen program development and research in the discipline.

4.4. *Training objectives and curriculum design*

In contrast to the situation in medical informatics education elsewhere in the world, in most of universities or colleges, the emphasis in terms of training objectives and curriculum design in medical informatics education is placed on the fields of literature information resources and management in most Chinese universities or colleges. Jan H. van Bemmel has noted that medical informatics is located at the intersection of information technology and the various specialties of medicine and health care, and it deals with the entire domain of medicine and health care, from computer-based patient records to image processing and from primary care practices to hospitals and regions of health care [33]. Today, the specialty of medical informatics is in place in a growing increasing number of universities in China. However, the objectives and curriculum design for medical informatics education differ substantially from one university to the other, and at many other universities, formal teaching in medical/health informatics has not yet been introduced into the curriculum.

In addition, the objectives and curriculum design of medical informatics education in Chinese universities or colleges are also quite different from those in foreign universities or colleges, for example, *the University of Heidelberg* in Germany [34,35], *University of Amsterdam* and *University of Limburg* in The Netherlands [36,37], *University of Utah* and *Washington University* in the US [26,38], and *the University of Toronto* in Canada [39]. Furthermore, the objectives and curriculum in Chinese educational institutions were developed by the individual universities or colleges and did not follow Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics (First Revision) [40].

Therefore, China needs to drastically reexamine and rework our training objectives and curriculum and open up new avenues for medical informatics education. At the same time, this country also needs to continue to become better integrated with medical informatics education in the rest of the world in terms of training objectives, curriculum, and educational system.

4.5. *Establishing and improving medical informatics education system*

Medical informatics as a discipline is still young, in particular when you compare it with other medical disciplines [27]. At the same time, The domain of medical informatics is not well defined [41]. There are many published definitions of individual subdisciplines within the domain, such as Medical informatics [42], health informatics [43], clinical informatics [44], nursing informatics [45], pharmacy informatics [46], public health informatics [47] and medical imaging informatics [48]. These subdisciplines require their own core curricula, training programs, and professional identities. The need for educational programs to train professionals to develop, implement, and evaluate these subdomain has been set up worldwide [49–53].

However, Chinese medical informatics education mainly focuses on the specialty of information management and information system and no subspecialty of medical informatics has been approved and recorded by the MOE. For example, almost twenty years ago, Chinese scholar called for nursing informatics education [54], but until now, no university or college, according to our survey, has set up the educational programs or the specialty of nursing informatics, and quite a few university offer the course of nursing informatics [55].

Therefore we should establish and improve medical informatics education system in China. On the one hand, we should establish and improve medical informatics education, On the other hand, we should establish new educations of subdisciplines within the domain, such as nursing informatics education, dentistry informatics education, Clinical informatics education, pharmacy informatics education, public health informatics education, health care management education, medical imaging informatics education etc. And then we integrate all of these education into medical informatics education system.

Author contribution

The paper was principally undertaken by Dehua Hu together with Zhenling Sun. Houqin Li is the guarantor of the article.

Competing interest

None of the authors have any conflict of interest, financial or otherwise, relevant to the conduct or reporting of this study.

Summary points

What was known before this study?

- The development of medical informatics in China is rooted in medical library and information science.
- Frequent changes in the specialty's name and an unclear identity have hampered the visibility of this educational specialty and impeded its development.
- Medical informatics education in China has developed significantly over the past 10 years.

What has this study added to the body of knowledge?

- There is a noticeable imbalance in the distribution of degree programs in medical informatics in different disciplines, with the majority falling under information management.
- There is a noticeable imbalance in the distribution of degree programs in medical informatics in different disciplines, with the majority falling under information management.
- There is also an uneven distribution of the specialty settings of medical informatics at the various academic levels (bachelor's, master's, and doctoral).
- The objectives and curriculum design of medical informatics education differ from one university to another and also from those of foreign universities and colleges.

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