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Mapping the Impact of Social Media and Mobile Internet on Chinese Academia's Performance: A Case on Telemedicine Research 2005-2013

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Abstract: Social media and mobile internet are both hottest topics in internet technologies which bring great challenges and wonderful opportunities for a large number of researchers in recent years. In some research fields, i.e., telemedicine or e-healthcare, Chinese researchers quickly took advantage of the spread of social media and mobile internet. In this study, we conducted a citation analysis with CiteSpace II by comparing the performance between researchers from China and advanced countries (e.g., USA) in Telemedicine field from 2005-2013. Although there remain huge gaps between China and developed countries, we found that social networks and mobile internet helped Chinese researchers to narrow the gap quickly in recent years. We also found that in the sub fields such as "SNS-facilitated telemedicine" or "m-healthcare", Chinese researchers even achieved similar performance as compared with world class researchers. These findings implicate that SNS or mobile internet may help researchers in developing countries to bridge the digital divide and enhance "late-mover advantage".

Keywords: Citation Analysis, e-Healthcare, Social Network, Mobile Internet, Chinese Academia
Categories: J.4, K.1, K.3, L.7

1 Introduction

At the big data era, researchers faced several challenges, such as: 1) how to find a new and effective working mode in changing environment [McMillan, 2000], 2) how to access the most recent research resources [Lotan, et al., 2011], and 3) how to manage the huge amount of scientific dataset [Lewis, et al., 2013]. However, social network and mobile internet may provide a new solution. Generally, social media

refers to "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content" [Kaplan &Haenlein, 2010], which include Linkedin, Wikis, Twitter, Facebook, Virtual Worlds, et al. While mobile internet, or mobile web, refers to access to the world wide web from a handheld mobile device (e.g., smart phone), connected to a mobile network or other wireless network.

Recently, numerous reports or studies reveal that social media and mobile internet are becoming the hottest aspect on internet [Jain, 2013, Labra Gayo, et al., 2010, Norman, 2010]. According to Nielsen [2012], the time people spend on social media or mobile internet in America increased rapidly from 88 billion minutes in 2011 to 121 billion minutes in 2012. In this case, social media and mobile internet are attracting more and more attentions in management study, computer science study and real business [Guo, et al., 2009, Zhang, de Pablos, et al., 2012, Zhou, et al., 2012]. According to IT's resource-based view (RBV) theory, mobile facilitated social networking service may rich the users' digital option and enhance their agility, then it may have several advantages for users: 1) richer communication channels; 2) higher communication frequency; and 3) higher levels of information sharing capability [Sambamurthy, et al., 2003, Zhang, et al., 2013, Zhang, Vogel, et al., 2012].

As one of largest internet business market with more than 564 internet population (by the end of 2012), China is getting into social network services and mobile internet [CNNIC, 2013a]. With the fast increasing popularity of smart phone, Chinese users would like combine social media and mobile into one concept, as they always use social media with their smart phone. According to another report of CNNIC, more than 60% of Chinese internet users will use social media, and about 90% of them will use SNS via App installed in their mobile operation systems (e.g., Apple OS or Android) [CNNIC, 2013b].

In China's Academia, utilization of social network or mobile internet seems has several potential values for researchers. First, compared with developed countries, Chinese researchers almost use social media and smart phone at same time, even some Chinese institutions have "late-mover advantage" that they may adopt most recent devices and techniques. Second, with help of social media and smart phone, Chinese researchers have more opportunities to access updated scientific data and publications. Third, they also may have more opportunities communicate with researchers from other countries (e.g., by using Linkedin), which may help them to focus on new topics and conduct international research.

Even numerous researchers have claimed the importance of social media and smart phone on China's Academia, empirical evidence is rare. One critical reason is that people are difficult to collect Chinese researchers' performance data, and compare them with world average performance data. In this study, we narrow the focus on special research field-"telemedicine", and have two research questions: *1. In the period of social media and mobile internet spreading in China (2005-2013), whether the Chinese researchers narrow the gap with developed countries? 2. In the emergent and new sub-field (i.e., social media or mobile facilitated telemedicine), whether Chinese researchers have better performance than the traditional telemedicine fields?*

We conduct a citation analysis on examining the research questions. First, we collect the international telemedicine researchers' publication and citation data from

Web of Science (an authorized dataset on international researchers), and collect Chinese telemedicine researchers' publication and citation data in CNKI (an authorized dataset on Chinese researchers). Then, with help of citation analysis software (CiteSpace II), we compared China with international performance in the whole telemedicine fields and sub-fields (i.e., social media or mobile facilitated telemedicine). The results and implications are presented from Section 4 to 6.

2 Case Background: Telemedicine Research in China

2.1 Development of Telemedicine Research in the World

As one important field in e-Healthcare, telemedicine refers to mutual information transmission among patients, hospitals and doctors. By using video conference systems, doctors can discuss the special case of operations. By adopting social supporting website, patients can share information and persuade each other. With help of wearable devices (e.g., smart watch, smart phone, google glass), patients may immediately upload their health information and get suggestions from doctors [Agarwal, et al., 2010]. Telemedicine has following advantages: improving the quality of treatment in rural areas, reducing patient medical costs, reducing diagnosis time, and facilitating to share medical equipment and education resources [Ekeland, et al., 2010].

Modern telemedicine system was born in US. In recent years, as development of ICTs, telemedicine grow very fast, and it became popular ways in treatment at US and Europe [Ekeland, et al., 2010]. In 2009, US president Obama proposed the first national telemedicine plan on investing $19 billion USD in the field of healthcare information technology. This policy encourages the researchers from US and other developed countries to conduct telemedicine and other e-Healthcare studies.

For the international community of telemedicine, researchers focus on system design, hospital adoption, industry development, and user behaviour [Ekeland, et al., 2010, Lehoux, et al., 2002]. In recent years, with development of new technologies, some researchers have focus on combing telemedicine with social media (e.g., twitter) [Terry, 2009], and mobile internet [Zyl &Harpe, 2012].

2.2 Development of Telemedicine Research in China

Telemedicine in China starts late, but developed rapidly. After 1995, China spent much money on constructing the long-distance telemedicine systems (e.g., Jin-Wei Net), and help hundreds of patients with complicated illness to get consultation service from doctors in Beijing, even overseas. However, in the early stage of telemedicine in China (1995-2005), government focused on constructing hardware but facilitating users to utilize it. Before 2005, rare patients have really adopted telemedicine to get treatment. In China's Academia, telemedicine was a small research field in medicine.

With the emerging of smart phone and social networks in recent years, Chinese people have more opportunities by getting into telemedicine by using App installed in smart phone [Consulting., 2009]. In China's Academia, more and more researchers from computer science, management, and other disciplines have strong research

interests on telemedicine, and several of them focus on the social media facilitated telemedicine, the updated and cross-discipline research.

3 Methodology and Data

This study used CiteSpace II [Chen, 2006, Suryanarayanan &Sam, 2012] and Web of Science (WoS) as tools for getting quantitative data and visualizing information of social media study. WoS provides some basic functions to help analyze papers in a selected dataset. CiteSpace II is software used analyze co-citation networks. It can give out statistic data and visualization of input dataset.

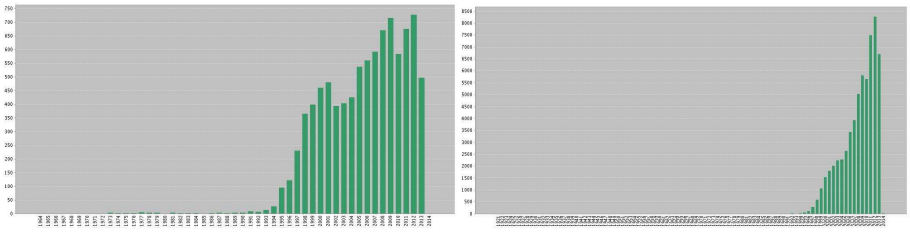
In this study, these tools were used to analyze development of telemedicine both from a comprehensive perspective and from perspectives of multi-nations (e.g., China and USA). Records of papers in WoS were used as datasets for this study. We searched for "telemedicine", "e-healthcare" in titles of papers on WoS, timespan was set "all years", "Science Citation Index Expanded (SCI-E): 1900-present", "Social Science Citation Index (SSCI): 1996-present" and "Conference Proceedings Citation Index Science (CPCI-S): 1990-present" were selected for Citation Database.

Finally, 9071 records were found. All the records were adopted for depiction of current status of telemedicine study. Then, records for worldwide group were selected by confining all the papers and ones for China group can be found by choosing authors as "P.R. China". By analyzing information of papers in these records, situation of these publications can be observed. And with help of CiteSpace II, citation data contained in these records can give out information about a much more wide range of publications.

4 Mapping Telemedicine Study in the World and China

4.1 Depiction of Current Status of Telemedicine Study

In Figure 1, we presented the numbers of publications and citations of Telemedicine study. As illustrated in figure, telemedicine study started far before, formed after 1995 and keeps developing now. These results suggest that influence of this field grows fast in recent years, and year 2005 is critical.



(a) Numbers (b) Citations

Figure 1: Published papers in each year of telemedicine study

As illustrated in Table 1, the important topics (by frequency) in telemedicine study are "telemedicine", "care", "system", "management", "telehealth" and so on. The hottest topics (by burst) are "teleradiology", "internet", "telepathology", "radiology", "association" etc. Obviously, telemedicine concentrate on care, system and management at the same time. All the highly related top topics suggest that telemedicine study is in a stable stage to brew new breakthrough. At the same time, some difference can be found through the hottest topics. These topics focus on more detailed studies. It can be predicted that more and more researches would emerge to deeply study specific aspects of telemedicine.

in Frequency			**in Burst**		
Freq	**Topic**	**Year**	**Burst**	**Topic**	**Year**
4212	telemedicine	1996	35.01	teleradiology	1996
758	care	1996	26.26	internet	1996
438	system	1997	19.62	telepathology	1996
425	management	1996	16.03	radiology	1996
414	telehealth	1999	14.58	association	2010
376	internet	1996	13.55	mortality	2010
339	technology	1996	11.62	diagnostic-accuracy	1998
252	health-care	1997	11.34	telehealth	1999
236	teleradiology	1996	11.21	emergency	1996
209	outcomes	2003	10.54	pacs	1996
203	e-health	2004	10.35	metaanalysis	2011

Table 1: Top 10 Topics in Telemedicine Study in Frequency and Burst

4.2 Stage of China's Telemedicine Study

USA is still the dominating country in telemedicine study. ENGLAND, GERMANY, AUSTRALIA, CANADA are all strong in this field. While China ranks 10th (Table 2). According to Figure 2, China is also the last one to study telemedicine in the top 10 countries.

Figure 3 shows the evolution of topics of telemedicine study in China and the whole world. The data of papers in China were downloaded through CNKI with the same search term in Chinese. Obviously, telemedicine study keeps developing from 1996 to 2013. Telemedicine became more popular especially in 2005-2010. More and more topics are related tightly with telemedicine in this period. And for telemedicine study in China, its influence is kept stable from 1996 to 2013. The influence of telemedicine in China is relatively lower. No significant topics were related to telemedicine in the evolution map which indicate that telemedicine study in China still needs more detailed study.

Freq	Author	Year
2693	USA	1996
543	ENGLAND	1996
528	GERMANY	1996
390	AUSTRALIA	1996
387	CANADA	1996
370	ITALY	1996
294	SPAIN	1996
235	JAPAN	1996
233	FRANCE	1996
218	PEOPLES R CHINA	1997

Table 2: Top 10 Countries in Telemedicine Study

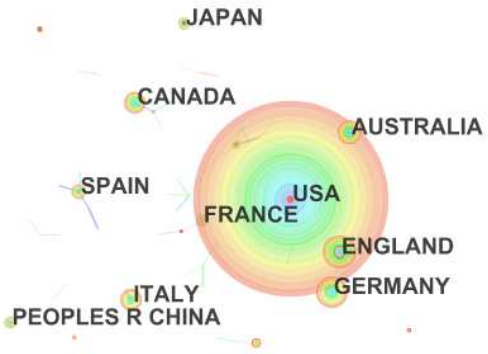


Figure 2: Top Countries in Telemedicine Study

5 Mapping Sub-Fields of Telemedicine in the World and China: Social Media and Mobile Facilitated Telemedicine

5.1 Status of Sub-Area of Telemedicine in the World and China

In order to clear China's telemedicine study from a deeper perspective, a sub area of telemedicine study was studied. We used the term "social network" or "mobile" to search in the dataset of telemedicine study. 869 papers were found as a dataset for the sub area of the whole world. Then we extract ones whose country value equals "China" in the 869 papers. In this way, 28 papers were got as dataset for the sub area of China. Through analyzing these dataset, status of the sub area of telemedicine study in China were compared with that in the whole world.

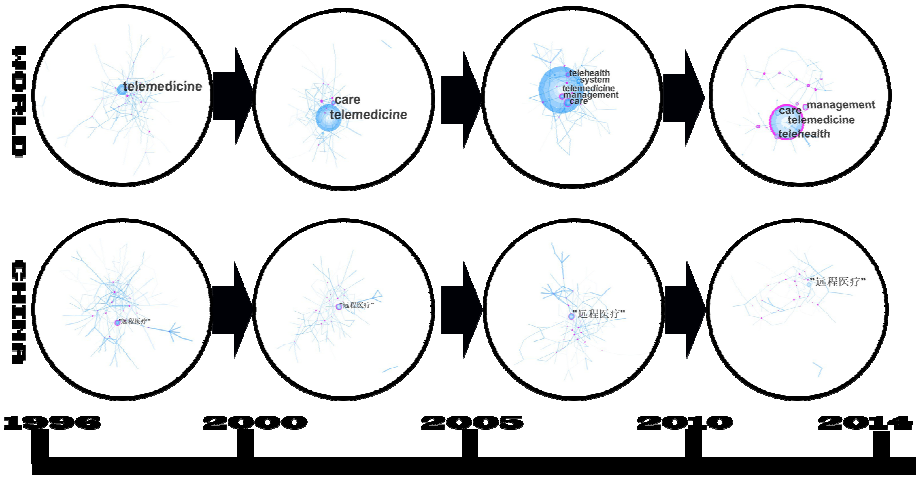


Figure 3: Evolution Map of Topics of Telemedicine Study in World and China (Note: "远程医疗"are Chinese words of "Telemedicine")

As shown in Table 3, the most important topics in this sub area in the whole world are "telemedicine", "system", "care", "management", "e-health", "mobile phone" etc.. At the same time "technology", "mhealth", "bluetooth" etc. are hottest ones recently. And in China, researchers focus on "telemedicine", "care", "mobile phone", "m-health", "e-health" etc., which contains both important ones and hot ones in the whole world. It means China is standing at the frontier of this sub area study now. When it comes to the bridging ones in China, they are "telemedicine", "management", "care", "wireless", "copd", "platforms" etc., which are tightly related to information technologies. This might shows great support from information technology study in China.

World			**China**		
Freq	**Topic**	**Year**	**Freq**	**Topic**	**Year**
372	telemedicine	2005	14	telemedicine	2007
63	system	2005	2	care	2010
60	care	2005	2	mobile phone	2011
42	management	2006	2	m-health	2012
36	e-health	2005	2	e-health	2010
31	mobile phone	2005	2	management	2012

Table 3: Top 6 Topics in the Sub Area of Telemedicine Study in Frequency

5.2 Status of Sub-Area of Telemedicine in China's Domestic Database

We also analyzed study in this sub area in Chinese in the database CNKI. Using the same searching terms, 115 records were found. From Table 4 we can conclude that although China only btained a limited number of papers in this sub area of telemedicine before 2009, it shows a high speed to catch up with the world in the number of published papers.

Year	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**
World	79	95	81	60	109	85	59	51	67	33	37	21
Chinese	24	33	16	13	11	4	7	8	8	8	4	8

Table 4: Number of Papers Published Each Year

Figure 4 is the evolution map of topics in the sub area of telemedicine study both in Chinese and in the whole world. As it is indicated in the map, China is narrowing the gap with the whole world rapidly in recent years. Before 2009, topics in this sub area in the whole world formed good clusters to support study in this area. In this period, China presents no good power to develop this field. It core topics "telemedicine" occurred on the evolution map stably only after 2008. The structure of clusters was loose. After 2008, this sub area keeps developing in the whole world and the influence of "telemedicine" is becoming bigger and bigger. At the same time, although China's study in this sub area is still behind the world's level, it developed rapidly. More and more topics are included in this sub area. And the influence of "telemedicine" is also becoming quite big if the smaller number of papers in Chinese (nearly 1/8 of the whole world) is taken into consideration.

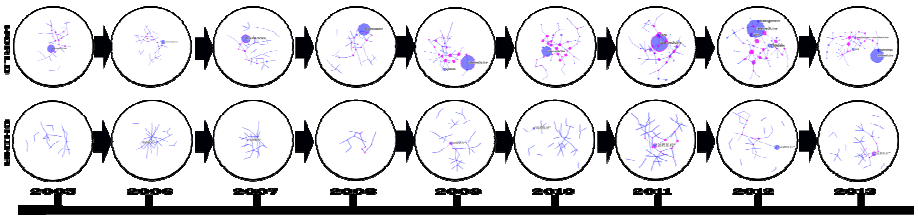


Figure 4: Evolution Map of Sub Area of Telemedicine Study in World and China

6 Discussion

According to the above results, we may have several findings related to answer the research questions. First, telemedicine study started far before, formed after 1995 and keeps developing now. Influence of telemedicine study also began around 1995, and increases faster after 2005. It seems the development stage of telemedicine research is associated with spread of social network and mobile internet in academia.

Second, we found China's telemedicine study is far behind the world level in early edge (1995-2005). China ranks 10th in the world in telemedicine study. And

China is also the last one to study telemedicine in the top 10 countries. The influence of telemedicine in China is relatively lower. Rare significant topics were related to telemedicine in the evolution map.

The third and most interesting find is about the sub area of telemedicine study, namely "social network" or "mobile", China is catching up very rapidly recent year in support of strong information technology study.

1) China is catching up with the world level by pinpointing critical authors in new trends of this sub area study. Far-reaching authors in China and whole world are entirely different. However, the most popular authors in both China and the whole world are relatively similar. The difference in the far-reaching authors shows China's shortage in the past, and the similarity in the popular authors recent years reveals China's rapid development of study in this sub area.
2) China is catching up with the world level by rolling into study of hot topics in this sub area. Hot topics in China in this sub area contain both important ones and hot ones recent years in the whole world. This indicates China's study in this field is not only relative new but also at the frontier. Some technical topics are critical in China's study. This might originated from the strong study of information technology in China. With support of the information technology study, China catches up with the new trend of study in this sub area.
3) China is narrowing the gap with the whole world rapidly in recent years both in publication numbers and in structure of topics in this sub area. From 2002 to 2009, the average number of papers in this sub area is 57.75 in world and 7.25 in China. And from 2010 to 2013, the average number became 78.75 in world and 21.5 in China. Meanwhile, more and more topics are included in this sub area in China. And the influence of "telemedicine" is also becoming quite big.

7 Conclusion

Based on these findings, we may conclude that the spread of social media and mobile internet (sometimes combined together) has a positive influence on improving academic performance of Chinese researchers. With the help of emerging technologies, Chinese researchers not only have more opportunities to learn and get into internaltional research community, but also take advantage of "late-mover advantage", to have similar or even better performance in the sub-areas related to social networks and mobile internet.

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