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Are Urologic Cell Phone Medical Applications in China's Market Available in Clinical Practice at Present? A Research based on Android System

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Abstract

Objectives: To find out the current situation about cellphone telemedicine in China, cellphone telemedicine for urology being analyzed specifically.

Methods: An online research on Android medical apps was conducted with google play app store. Medical apps met inclusion criteria were recorded and analyzed. Medical apps for urology were specially studied.

Result: General medical apps and urology-specific apps could both be divided into following groups with following numbers and proportions: for patients (239, 45.5% vs. 35, 50.0%), for doctor-patient interaction (DPI) (17, 3.2% vs. 4, 5.7%), for doctors (169, 32.2% vs. 23, 32.9%) and for medical education (100, 19.0% vs. 8, 11.4%). "For patients" and "for doctors' group could be further divided by app functions.

Conclusion: Functions of medical apps in China's market have already covered a large range of fields. Apps facing single group of users, either patients or doctors, take the majority and can be useful in some clinical practice. Apps for doctor-patient interaction are still far from sufficient and perfect and development should be achieved in both amount and function. Further studies should be conducted on cost-effectiveness.

Keywords: Telemedicine; Android operation system; Smart phone applications

Background

Workforce of medical services being relatively insufficient is one of the biggest problems faced by China's health care industry, which is known as "difficult to receive medical treatment" to most Chinese. According to WHO, numbers of physicians per 10000 population are 14.6 and 15.2 in country and regional area respectively, while those of nurses and midwives are 15.1 and 19.5. For reference, the physician number of USA is 24.2 in country and 20.4 in regional area with nurse and midwife number being 98.2 and 71.5. Lacking workforce leading to excess workload on medical staff and unpleasant experience in seeing doctor. Most of the clinical doctor's work over 60 hours a week and even on China's spring festival can they have an only 3.4-day rest, when the legal holiday supposed to be 7 days [1]. However, abundant work hours are not able to fill the gap of insufficient visit time for every patient on average and do not result in satisfaction of patients. As patients in China afford most of treatment costs themselves, which is considered as a vital cause of discontent of them [2], and they think their payment must bring back remarkable therapeutic effect [3], they will easily be offended if doctors don't provide the service they expect. Some patients even vent their dissatisfaction with doctors in violent ways and make doctors the victim of injury or death [4]. Thus, in order to avoid tragedies coming up again, how to make it cheaper and easier to see a doctor becomes one of the most essential questions waited to be solved at present. Since the number of doctors won't be able to change rapidly to meet the patients' need neither will the mode of payment, telemedicine is considered to be a reasonable solution to this serious problem. Some people believed that telemedicine can be an effective technique able to promote patient-doctor communication and health care outcome and meanwhile save costs of money and time for patients [5].

And because of the popularization of personal cell phones and development in communication technology, cell phone is now a promising platform to imbed telemedicine. Previous studies have proven that information from cell phone including short message and voice can enhance health care outcome [6]. Also, many studies report that present smart phone operate systems, such as Android, are qualified to achieve lots of functions which are helpful in clinical practice [7-9]. According to statistics from Ministry of Industry and Information Technology (MIIT) of the

People's Republic of China, the popularizing rate of cell phone of season 3 year 2013 in China is 89.2 per hundred people and the data flow of mobile Internet access is 128.3MBs per month for each user, indicating the huge potential market of cellphone-based telemedicine in China. China healthcare industry invested RMB 17.08 billion in IT solutions in 2012 and this number will grow up rapidly in the following 4 years driven by mobile application (app) developments since mobile apps have become the key feature in hospital Informa ionization projects [10]. Therefore, as urology surgeons in China, we are very curious about whether medical apps in present China's market are available in clinical practice, especially to that of urology. However, so far there is no literature able to figure it out. Thus, we conducted an online research to explore the profile of published medical apps in China's app market.

Methods

We did an online research from May 4th, 2012 to Nov 14th, 2019 through the internet in Sichuan University, Chengdu, China. We chose medical apps for Android operate system as samples because Android took over 80% of the operate system market in China and would stay stably at this level in the next few years [11]. This made medical apps for Android able to reach the biggest range of users and may have a most remarkable effect on China's medical services. Google play apps store served as our source of raw data since we thought as the official apps store, google play could provide us with the most comprehensive and accurate information on apps as well as guarantee the quality of apps to some degree. We learned introductions and recorded all eligible apps under "Medical" and "Health and Fitness" lists. Also, we searched the whole store by following key words: urology, kidney, ureter, bladder, prostate, urethra, stone, andrology and genitourinary (all in both English and Chinese) for apps specific on urology. We divided the included apps into 2 major group: overall group, recording the apps from the given lists and represented the state of medical apps in general; urology-specific (US) group, recording apps from search outcomes and representing state of US apps only. Meanwhile we set different subgroups according to apps' functions and target users. The inclusion criteria was as followed: designed for human medicine only; designed in English or Chinese language; app functions were clearly described in app introductions; apps with same titles, functions and companies but different version (including LITE, FREE, TRIAL, DEMO, FULL, for common users and for doctors) would be recorded for once only; only when apps appeared in both app lists and search outcomes could they be recorded in both overall group and US group. SPSS 19.0 for Windows was used for chi-square test to analyze the constituent ratio of different groups of apps.

Result

Table 1: Profile of overall and urology-specific medical apps, by target user and language.

Target User	Overall (n)*			Urology-Specific (n)*		
	English	Chinese	Total	English	Chinese	Total
For patients	113(21.5%)	126(24%)	239(45.5%)	31(44.3%)	4(5.7%)	35(50.0%)
For DPI	4(0.8%)	13(2.5%)	17(3.2%)	2(2.9%)	2(2.9%)	4(5.7%)
For doctors	132(25.1%)	37(7%)	169(32.2%)	23(32.9%)	0	23(32.9%)
For ME	96(18.3%)	4(0.8%)	100(19.0%)	8(11.4%)	0	8(11.4%)
total	345(65.7%)	180(34.3%)	525(100%)	64(91.4%)	6(8.6%)	70(100%)

*Percentages in the brackets after count numbers represent the proportion every subgroup takes from the total number of the whole group. DPI: Doctor-Patient Interaction; ME: Medical Education.

The final number of medical apps included in the current research was 525 while that of urology-specific apps was 70. Apps designed in English took more proportion than those in Chinese in both overall group and US group (P<0.001 vs. P<0.001, respectively). By target user these apps were divided into the following 4 subgroups: for patients (239, 45.5% in overall group vs. 35, 50.0% in US group), for doctor-patient interaction (DPI) (17, 3.2% in overall group vs. 4, 5.7% in US group), for doctors (169, 32.2% in overall group vs. 23, 32.9% in US group) and for medical education (100, 19.0% in overall group vs. 8, 11.4% in US group) Table 1. No significant difference existed between overall group and US group in the distribution of these 4 subgroup in general (p=0.344), but when take language into account difference showed up in "for patients" and "for doctors" subgroups (p<0.001 vs. p=0.009). We then studied the details of app distribution in "for patients" and "for doctors' group. We found that these two subgroups could be further divided by the specific functions of different apps. Apps in "for patients" were divided into 6 parts: record & remind, to record data from users a as database and/or to remind users of things they plan to or need to do at certain time; self-check & therapy, to allow users to diagnose themselves by symptom check and/or to give users advices on therapy; patient education, to provide information on specific diseases which should be taught to patients; health seeking assistance, to provide information on doctors, hospital or drug store or to provide services helping date and register; sign detector, to detect signs of patients through equipment attached to cell phones, camera and microphone for example; multi-function, a combination of

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two or more functions mentioned above Table 2. Apps in "for doctors" were divided into 9 parts: guideline, to provide guideline, pathway or references on diagnosing and treating; calculator, to calculate index or drug dose with provided data; drug reference, to provide suggestions and cautions on pharmacotherapy; literature, to provide service on searching, scanning, downloading and managing publications; dictionary; clinical decision support system (CDSS), a combination of calculator, guideline and/or drug references; data management, to help manage medical records on cell phone; information, to provide news on medicine, plans of conferences or web forum for doctors; integrated platform, a combination of two or more functions mentioned above Table 3.

Table 2: Profile of overall and urology-specific medical apps for patients only, by language and function.

Function	Overall (n)*			Urology-Specific (n)*		
	English	Chinese	Total	English	Chinese	Total
Record & remind	36(15.1%)	46(19.2%)	82(34.3%)	4(11.4%)	0	4(11.4%)
Self-check & therapy	19(7.9%)	23(9.6%)	42(17.6%)	5(14.3%)	0	5(14.3%)
Patient education	20(8.4%)	30(12.6%)	50(20.9%)	14(40.0%)	2(5.7%)	16(45.7%)
health seeking assistance	13(5.4%)	17(7.1%)	30(12.6%)	7(20.0%)	0	7(20.0%)
Sign detector	25(10.5%)	3(1.3%)	28(11.7%)	1(2.9%)	0	1(2.9%)
Multi-function	0	7(2.9%)	7(2.9%)	0	2(5.7%)	2(5.7%)
Total	113(47.3%)	126(52.7%)	239(100%)	31(88.6%)	4(11.4%)	35(100%)

*Percentages in the brackets after count numbers represent the proportion every subgroup takes from the total number of the whole group.

Table 3: Profile of overall and urology-specific medical apps for doctors only, by language and function.

Function	Overall (n)*			Urology-Specific (n)*		
	English	Chinese	Total	English	Chinese	Total
Guideline	23(13.6%)	2(1.2%)	25(14.8%)	4(17.4%)	0	4(17.4%)
Calculator	20(11.8%)	3(1.8%)	23(13.6%)	1(4.3%)	0	1(4.3%)
Drug reference	13(7.7%)	5(3.0%)	18(10.7%)	0	0	0
Literature	17(10.1%)	5(3.0%)	22(13.0%)	2(8.7%)	0	2(8.7%)
Dictionary	25(13.6%)	2(1.2%)	27(16.0%)	0	0	0
CDSS	5(3.0%)	3(1.8%)	8(4.7%)	1(4.3%)	0	1(4.3%)
Data management	6(3.6%)	2(1.2%)	8(4.7%)	0	0	0
Information	22(13.0%)	12(7.1%)	34(20.1%)	15(65.2%)	0	15(65.2%)
Integrated platform	1(0.6%)	3(1.8%)	4(2.4%)	0	0	0
Total	132(78.1%)	37(21.9%)	169(100%)	23(100%)	0	23(100%)

*Percentages in the brackets after count numbers represent the proportion every subgroup takes from the total number of the whole group. CDSS clinical decision support system.

Discussion

Through the current study we find that functions of medical apps in China's market have already covered a large range of fields but still have some imperfections. Apps facing single group of users, either patients or doctors, take the majority of all medical apps while apps which are able to achieve communication between doctors and patients over internet still stay at a very low level. We don't take medical education apps into discussion since they are mainly designed for medical student who won't attended much clinical practice in China.

Medical Apps Designed for Patients only in General

We are pleased to find out there already exist loads of apps aiming at recording/reminding information, quick self-diagnosing and self-treating, assisting appointments and educating patients. Krishna S [6] believed that cell phones with these functions can help standardize medicine taking, improve patient teaching and training and reduce failed appointments, resulting in improved health outcome. About half of them are in Chinese, which make them friendly to Chinese users. The major limitation of these apps is that the information sources of them are either local or online databases, lacking person-to-person communication from professional health staff. So, information from these apps may make people with few medicines knowledge background confused in some complicated condition. As for apps for sign detecting, we remain doubtful about the accuracy of data collected by cell phone hardware which is not designed for medical use initially. Further studies are needed to prove whether cell phone can be reliable sign detectors.

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Medical Apps Designed for Patients Only and Urology Specifically

Unlike the situation in general, the number of apps for urology specifically are far from sufficient, apps in Chinese especially. We consider apps for patients with genitourinary system problems to be necessary since functions such as voiding diary [12], water-drinking [13] reminder and PSA recording can be helpful for them. Also, patient education may reduce recurrence rate and improve quality of life in some urologic diseases. However, the current search only found 35 apps in this field in total while 88.6% of them were in English, which may be inconvenient for many Chinese patients. This current situation suggests that more apps in Chinese need to be developed in this field.

Medical Apps Designed for Doctor-Patient Interaction

The conditions of included DPI apps in overall group and US group were similar so we decide to discuss them together. DPI apps can provide telemedicine services. Through out-of-hospital internet communication with doctors they allow patients to receive professional health services without attending hospital. By online history taking doctors can give advice on diagnosis and therapy as well as decide whether it is necessary for a patient to attend a hospital, so as to reduce unnecessary hospital visits and save time and money for patients. We believe this kind of apps can be an ideal telemedicine platform to relief the conflict between Chinese patients and doctors. However, these doctor-patient interaction apps are far from perfect at present. One outstanding shortage is the quantity. PDI apps in Chinese and available to hospital in China only take very small part of the whole (2.5%, 95% CI 1.3%-4.1% in general vs. 2.9%, 95% CI 0.3%-9.9% in US). Differ from apps designed for single part of users, communication apps require more data flow on internet. Also, one app isn't able to reach a very large range of doctors and patients. Thus, only a few apps cannot hold the large quantity of Chinese patients. We also tested some of the hottest present DPI apps and found the following limitations. Firstly, the consultation systems of most DPI apps were just simple message boards without standard forms for information input, which made symptom descriptions from patients could sometimes be incomplete or confused. And since the message boards are not real-time conversations but more like check and reply e-mails, incomplete or confused information could prolong the time of online diagnosis. Also, the message boards didn't differ for different clinical departments, which made it difficult for doctors to use some specific tools, IPSS scale for urology for example, to perfect their history taking. In addition, these apps had on link to any hospital information systems. Thus, doctors couldn't obtain the past health history of their online patients through cell phone, which may lead to inappropriate diagnosis. And when apps users were not binded to a certain hospital or doctor, it could be difficult for patients with chronic disease to get best monitoring or for doctors to do follow-up. Improvement should be achieved in these aspects.

Medical Apps Designed for Doctors Only

Medical apps designed for doctors can simplify clinical practice in many aspects, including decision making, data managing and information obtaining. The common defect shared by both general and US medical apps is the short of apps in Chinese. Although English study has been put in a more important place than ever before in medical education, elder doctors, those in rural areas and those in primary hospitals may still have problems in English and Chinese may help them better [14].

Limitation of the Current Study

Selection bias existed in the current study. For lacking complete internet access required, we could only access part of the top free app lists from google play, so the outcomes of the current study couldn't represent that of all medical apps. Nevertheless, Chinese users share the same access of ours so they may hardly get more than what we have recorded from google app store. Also, apps we recorded were all top sellers since the lists we reached sorted apps by the total downloads, which meant apps we included had the largest user amount and would have a biggest effect on clinical practice in China. Our study explored the current situation of medical apps in China's market and also introduced some advice, but it was not a cost-effectiveness research and couldn't reflect how exactly telemedicine apps would change our medical work. Controversy upon cost-effectiveness of telemedicine still exists [15,16], and few studies on it have been conducted in China. Therefore, further studies should be conducted to fill this gap.

Conclusion

Apps designed for either doctors or patients make up the majority of medical apps at present. They can improve the ability of self-healthcare for patients and provide suggestions on diagnosis and treatment, which will simplify the medical practice and improve health outcome to some degree. Limitation in app language should be noted and more Chinese apps wait to be developed to fit the need of Chinese users. On the other hand, apps for doctor-patient interaction are still far from sufficient and perfect and development should be achieved in both amount and function. Only then can they supply more effective and efficient telemedicine services. In addition, more randomized controlled trials should be conducted to explore the cost-effectiveness of telemedicine in China.

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