Research on Credit Evaluation of Mobile Medical APP
Interactive Online Consultation Service-Take Haodaifu APP
Online Payment Service as an Example

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Abstract. Mobile medical industry is developing rapidly, but the relevant credit evaluation system is still in the exploratory stage. Haodaifu in the interactive online consulting services more representatives and has a credit evaluation system, but the system is not perfect. There are many problems in the system, such as credits indicators cannot better reflect the results of user’s evaluation, the lack of user qualification supervision, evaluation index system and assessment channels are not perfect. On the basis of drawing on the advantages of E-commerce evaluation system and combining with the characteristics of mobile medical itself, two suggestions are put forward: Improve the credit evaluation model (Generate physician static credit index, Change the doctor ‘s dynamic credit index algorithm, Update the dynamic credit index), Improve the basic mechanism of credit evaluation.

1. Introduction
China's serious shortage of medical resources combined with uneven distribution of resources, leading to "medical difficulties" has become a major problem in today's society. Huge market demand gave birth to a new economic growth point. Now, the Internet develops rapidly, and mobile health came into being. Data show that as of June 2016, the size of Internet users in China reached 7.10 billion, and the Internet penetration rate reached 51.7%, which more than the global average of 3.1 percentage points. China's mobile phone user’s scale up to 656 million, of which the use of mobile Internet accounted for 92.5%, and only through mobile Internet Users accounted for 24.5%. Internet users further focus on mobile devices.[1]. In this context, mobile medical APP mushroomed, there are already more than two thousand related APP come out. Another data show that in March 2016 medical category APP monthly active users (MAU) reached 47.089 million, which is an increase of 547.0%[2]

The development speed of mobile medical APP is faster than imagined, but the quality of development is worrying. Many commercial advertising and bidding model triggered public distrust of mobile medical. The healthy development of the industry is inseparable from the credit management, and now the mobile medical industry credit evaluation system need to be built to standardize corporate behavior, while providing users with valuable basis for judging.

At this stage, the mobile medical APP function for the patient category is divided into the following categories: (1) Non-interactive medical information services. In other words, the interaction between people and intelligent machines. A typical example is the current large number of medical and health program software that with intelligent procedures for patients to make a preliminary diagnosis and to provide patients with treatment recommendations. (2) Interactive online medical counseling services. Specifically, patients and doctors through the Internet for online communication, such as doctors and patients interactive platform(3). Health monitoring guidance(4). Pharmaceutical e-commerce
services(5). Medical service process optimization(3). Among them, interactive online medical advisory services accounted for a large proportion of users. And it’s influencing factors, especially the risk factors more than other types.

2. Haodaifu Online Credit Evaluation System Status

Haodaifu online was founded in 2006, which is one of China's representative medical information and doctors and patients interactive platform. At the beginning of the creation, Haodaifu online focus on providing patients with medical reference information, and it established the first online real-time updated information query system. Today, the Haodaifu online has included 484,186 doctors of 7291 regular hospitals, and of which 142053 experts online Q & A. Data show that in 2016 (as of August 12 data date), Haodaifu online daily average number of active users has been increasing, of which 4, 5, 6 months, the number of active users increased rapidly, and the number of active users after June has remained at 1.5 million(4). At present, Haodaifu online interactive medical counseling service main function classification as shown in Table 1:

Compared with free online consultation, paid online consultation has a greater advantage in the determination of doctor, counseling and waiting time. So paid online consulting increasingly becomes the main product of online consulting services. The credit evaluation system referred to in this paper is also mainly for paid online consulting services.

| Table 1 Haodaifu online interactive advisory service classification table |
|-----------------------------|---------------------|--------------------------|
| Free online consultation    | Online consultation | Specified doctor's free clinic |
| Online consultation         |                    | App arranged for a doctor to answer |
| Paid online consultation    | Telephone consultation | The patient selected the doctor to answer |
|                            | Video consultation  |                                        |

Haodaifu online APP has now built an initial credit evaluation system:

The first is information disclosure. The doctor introduction page is mainly composed of the following parts: name, title, hospital and department, patient vote, professional good, practice experience, visiting location, patient evaluation, online inquiry, expert article.

Followed by service assessment. The most intuitive one is the "patient vote", the patient vote to the doctor to assess the situation, and the evaluation page is divided into two parts. The first part is the treatment process and the results of the evaluation, including the name of the disease, the purpose of treatment, treatment, treatment process evaluation, doctor costs, and the current condition. Among them, the treatment process has two main evaluation indicators: treatment results and treatment attitude. The second part is the information collection for medical treatment, including why choose the doctor and the registration route.

In addition, Haodaifu online interactive counseling service has a core evaluation index: "patient recommended heat". This indicator is based on the doctor's medical background, practicing experience, patient voting, doctor reports and the strength of the department where the doctor worked at, similar to the shopping site business credit rating. When the patient to find a doctor, the doctor list by default in accordance with the "patient recommended heat" from high to low, so when the patient choose to seek medical treatment, this indicator has a great impact on patients.

At present, the good doctor online APP evaluation system mainly exist the following deficiencies:

2.1 "Patient Recommended Heat" Can Not Better Reflect the User's Evaluation Results

As mentioned earlier, "patient recommended heat" is mainly based on the doctor's background, practice experience, the patient's vote and the strength of the doctor's department, etc. we can see that this indicator is not closely linked with the user’s evaluation.

First of all, the impact of "patients recommended heat" factors are mostly doctors static credit indicators, such as medical background, the strength of the department, etc., which shows that the score of "patient recommended heat" is more reflected in the doctor's qualifications and background,
it does not reflect the user's medical experience evaluation.

Second, in the "patient recommended heat", the only factor associated with user evaluation is "patient vote" that is too general. Patient voting means praise, on the contrary, the patient does not vote that means non-praise. That is, 80% of the satisfaction of the vote and 90% of the satisfaction of the vote on the "recommended heat" has the same effect. For example, in the Haodaifu online APP found such a phenomenon. In the "gynecological department" link, Dr. Hong (attending physician) whose number of patients voting is 681, and whose efficacy and attitude are 100% satisfied and the patient recommended heat score 4.7; Dr. Chen (chief doctor) whose number of patients voting is 361, and whose efficacy and attitude are 99% satisfied, but the patient recommended heat score 5.0. This shows that due to the title or hospital department strength, doctors whose patient satisfaction and the number of votes are high may not have high score in patient recommended heat. This simple hierarchical division makes it difficult to truly and accurately reflect the results of user's experience evaluations.

2.2 Evaluation Index System Need to Be Improved

Although the Haodaifu online APP online evaluation contains a number of evaluation indicators, but only have two indicators to evaluate the doctors (medical) services: "treatment result" and "service attitude." This simple evaluation certainly cannot fully reflect the doctor's comprehensive credit situation. On the one hand, these two indicators are too general in the connotation, so patients can not accurately understand the connotation of indicators when they evaluate doctor's treatment. On the other hand, some indicators can also reflect the quality or effect of a doctor's service (treatment) to some extent, but these indicators are not included in the assessment system, such as "rational medication", "treatment" and "waiting time".

2.3 Lack of Supervision of the Evaluator's Qualifications

The Haodaifu online platform does not effectively qualify the evaluator (user or patient) qualification. The current online platform does not require users to authenticate the real name information; the patient simply by phone number can be registered as a user. Although in principle only requires users who have received medical counseling services can evaluate doctor's services (treatment), but the software platform does not set a valid user screening system. In other words, any registered user can evaluate any doctor (whether or not he or she has received the doctor's Treatment or counseling service). This simple authentication system and the lack of regulatory evaluation mechanism lead to such as vicious competition or malicious negative feedback and other phenomena, but also lead to the authenticity of credit evaluation are not guaranteed.

In addition, the influence of the evaluation provided by the users of different identities and qualifications should be treated differently. But in the good doctor online platform system only set the membership system, and the platform did not record the user's credit index. So on the platform, although the evaluator's identity and qualifications are different, but their evaluation of the "patient recommended heat" is the same impact.

2.4 Evaluation Channels Need to Be Improved

The current user evaluation channels mainly exists the following two questions:

First, fewer people involved in the evaluation. From the Haodaifu online doctor introduction page can be seen, comment participation rate is not high. The majority of patients participating in the assessment are less than 10% of the number of online counseling (The Haodaifu online has eight departmental categories, the study selected a branch department in each departmental category randomly and statistics of the top ten doctors evaluation, The results showed that a total of 80 doctors, of which 80% (i.e., 64) of the number of patients assessed less than 10% of the number of online consultation), which cannot give a better reference for other users.

Second, the majority of users involved in the evaluation are patients who received treatment. The evaluation content settled by Haodaifu online have a certain targeted. A lot of content mainly for patients who received treatment face to face, such as the purpose of treatment, treatment, treatment costs, registration path, etc., it can be seen Haodaifu credit evaluation system is still the services evaluation of doctor's traditional offline treatment. But nowadays online medical counseling service,
APP only provides a platform for patients and doctors to communicate, and the doctor's treatment and the APP operator is not linked. The essence of the Haodaifu online evaluation system is still the evaluation of the traditional medical process, and the system does not design the targeted credit evaluation on the basis of mobile medical characteristics.

3. Haodaifu Online APP Credit Evaluation Model Construction

In view of the above situation and shortcomings and reference to the more mature e-commerce credit evaluation system, this study attempts to improve the credit evaluation system of Haodaifu online consulting service, including the generation of "doctors static credit index", change the doctor dynamic credit index Algorithm, and in accordance with the time series to update the credit index. Specific improvement model shown in Figure 1:

![Figure 1 Improved Online Credit Rating Model](image)

3.1 Physician Static Credit Index

The doctor's static credit index is calculated as follows:

$$M = \sum_{i=1}^{n} (C_i \times W_i), i=1,2,3,\ldots$$

Note, M: physician static credit index; Ci: score of indicator; WI: weight of corresponding indicator.

The above is the specific calculation of doctor static credit index, if you want to ensure the authority of the static index, but also to ensure that the relevant indicators information is true and accurate. Haodaifu online can be in cooperation with the doctor's hospital and the relevant health supervision departments to access to authoritative information, thus the doctor's static credit status can be assessed comprehensively. At the same time, pay attention to the credit index update, you can set the update cycle to update periodically. The renewal process plays a vital role in the improvement of the credit evaluation system, although it is complex and time-consuming and labor-intensive.

3.2 Considering the User's Credit Level

Now the field of e-commerce more use of two-way evaluation model, that buyers and sellers can give each other scoring according to their behavior in the transaction, and they can monitor each other, which is a more scientific evaluation model. The two sides of the transaction personally participate in the evaluation is the basis of the bidirectional evaluation model to ensure its authenticity and validity. Electric providers can hire more staffs to communicate with customers and participate in the evaluation, but the medical profession is highly professional, and doctor must be involved in the entire transaction process himself. If a two-way evaluation model is used, the physician needs to evaluate each patient, which will spend a lot of time and reduce efficiency, thereby increasing the degree of lack of medical resources. So this model uses a one-way evaluation model, the user credit index by a
number of indicators and calculated by the system.

3.3 Change the Doctor Dynamic Credit Index Algorithm

Dynamic credit index algorithm mainly from two aspects to improve: First, the user evaluation using the five-level scoring system, and second, considering the user's credit level.

In practice, you can choose persons who are experienced in this field, and they use the assignment method to quantify the qualitative indicators. And the expert law can be used to determine the corresponding weight of the indicators. This article combines the traditional medical evaluation indicators and mobile medical characteristics and we set a series of indicators as a reference, see Table 2:

| Table 2 Physician Static Index Assessment Indicators Detailed Table |
|---------------------|------------------|-----------------|-----------------|-----------------|-----------------|
| Indicator            | Index weight     | Indicator level division | Each grade corresponds to score (Ci) |
| Hospital grade       | W1               | Level 1             | Level of first-class | Level 2         | Second level of first-class | Level 3 | Top 3 |
|                      |                  | Resident Doctor     | 1                  | 2               | 3               | 4               |
| Doctor level         | W2               | Doctor-in-charge    | 5 years and below  | 5-15 years      | 15-25 years     | 25 years and above |
| Time                 | W3               | The primary responsibility for the first and two level | 1                  | 2               | 3               | 4               |
| Medical malpractice  | W4               | The secondary responsibility for the first and two level | -4                 | -3              | -2              | -1              |

(Note: hospital grade is based on the classification of Haodaifu online platform.)

User credit index formula:

\[
T = \sum_{i=1}^{n} (A_i \times W_i), \quad i=1, 2, 3, \ldots
\]

We can calculate the user credit index according to the above indicators and algorithms, and the existing credit index algorithm have been changed, when we calculate the doctor dynamic credit index the user's credit should be considered. That is, different credit levels of user evaluation have different influences on the doctor's credit index, so that the credibility of the doctor's credit index to be ensured.

Doctor dynamic credit index formula:

\[
P = \sum_{i=1}^{n} (T_i \times S_i), \quad i=1, 2, 3, \ldots
\]

Note, P: physician dynamic credit index; Ti: user credit index; Si: corresponding user to the corresponding doctor's credit score.

Using Five-Level Scoring System

In the calculation of the doctor dynamic credit index using scoring system, great, good, average, poor, very bad corresponding to the score of 5, 3, 0, -3, -5.

The doctor's credit score is calculated as:

\[
S = \sum_{i=1}^{M} M_i, \quad i=1, 2, 3, \ldots
\]
3.4 Credit Index Update

The rapid development of medical technology and the accumulation of clinical experience make the disease cure rate increased rapidly. Therefore, the doctor's treatment and evaluation in different periods have different influence on the user's choice when they consider which doctor is better, generally speaking, the user may refer more to the recent data. Corresponding, different periods of evaluation scores on the doctor's credit index should also be different, so more timeliness. Based on above considerations, the evaluation model of the historical data and the current data need to be calculated differently.

\[ P^\text{^+}=P_1^\text{^+}*u_1^\text{^+}+P_2^\text{^+}*u_2^\text{^+}+\ldots+P(n-1)^\text{^+}*u(n-1)^\text{^+}+P_n^\text{^+} \]

Note, \( P^\text{^+} \): a doctor's patients recommended heat in n period, that is, a doctor's total dynamic credit index in n period; \( P_n \): a doctor's dynamic credit index in n period; \( u(n) \): the history credit decline coefficient in n period.

Scholars Colin F. Camerer’s study\(^5\) have shown that environmental changes, forgetting and other factors have influence on the decline coefficient, and \( u \) range of values: \( 0 <= u <= 1 \). If the historical transaction activities and the current transaction activity are relatively high, the decline is less, so the value of \( u \) is lager, such as between 0.6-1. Conversely, if the consistency is low, so the decline is large, \( u \) can be between 0-0.4.

In modern society people's life is fast, so people can change their concerns in a short time. E-commerce field to Taobao, for example, found that users less concerned about the transaction information before six months, mainly focused on trading activities nearly a month. Products of mobile medical are medical services, the nature of which is special, so users may be more conservative than online shopping. Therefore, this article assumes that when a medical activity occurs in:

- A year ago, the credit decline coefficient between 0-0.4 value;
- More than three months and within a year, the recession coefficient \( u \) in the 0.6-1 value;
- Within three months, there is no recession, \( u \) take 1.

The credit index needs to be updated regularly. According to the time node of \( u \) value, the credit index can be updated for three months, and the platform can calculate the accurate patient's recommended heat value.

Note, \( S \): the user to the doctor's credit score; \( M_i \): the user to the specific evaluation index scoring

Note, \( T \): user credit index; \( A_i \): the amount corresponding to the indicator; \( W_i \): the weight of the corresponding indicator.

User credit index indicators can also be used to quantify the indicators and expert law can also be used to determine the indicator's weight, the specific content in Table 3.

| Indicator                                    | Index weight | Index scoring rules               |
|----------------------------------------------|--------------|-----------------------------------|
| Number of consultations (paid)               | W1           | \( A_1 \): number of paid inquiries |
| Accumulated consumption amount               | W2           | \( A_2 \): Accumulated Consumption Amount / 50 |
| Bad comments account for the overall percentage of individual comments (\( X=\)The number of bad comments / Individual total number of evaluations) * 100% | W3           | \( X \geq 60\% \) \( \text{or} \) \( X < 60\% \) |
| Registration time                            | W4           | \( A_3=-4 \) \( \text{or} \) \( A_3=0 \) |

| Years and above | 3 years and below | 3-10 years and above |
|-----------------|-------------------|----------------------|
| A4=2            | A4=4              | A4=6                 |

4. Improve the Extensive Support System of Credit Evaluation

The extensive support system of credit evaluation is the basis of credit evaluation model’s practicality
and scientific. Only the extensive support system to be perfect, users can conduct an effective evaluation, and follow-up credit index accounting and other links can be carried out. The extensive support system to be improved mainly from the following three aspects:

4.1 The Qualifications of Evaluators Should be Supervised Strictly
First, the user real name authentication that is the basis for recording the user's credit index, and it can make the entire evaluation system more standardized. Meanwhile, only users who received a doctor's medical consultation service can evaluate this doctor. The evaluation of who have not personally experienced medical counseling may only be based on "heard", there is a certain degree of evaluation bias, and the evaluation don’t have much reference value.

4.2 Subdivide the Evaluator and the Indicator and Establish the Incentive Mechanism
First, subdividing the evaluator. Users will be divided into two categories: understand the doctor information from the APP and then accept the medical diagnose face to face, online consultation users. Two types of users enter their respective evaluation pages and fill in different evaluation information. For these two types of users, the evaluation of different priorities, indicators should also be set differences. Evaluation indicators can be subdivided from two aspects: add new indicators, refine the original indicators. New indicators should be clear, objective and comprehensive, and then the indicator will be graded, each one level of indicators refined into a number of secondary indicators, so that users can understand the meaning of indicators accurately. In addition, you can also add an open topic to encourage users to fill in their own want to fill the indicators, so that enterprises understand customer’s needs, and then constantly improve the credit evaluation system according to users’ suggestion. Open topics are not included in the credit index accounting. At the same time Haodaifu can establish incentives, give users some gift after they finished the evaluation, such as the gift coupons, good beans or free consultation, so that the enthusiasm of the user evaluation can be improved.

4.3 To Strengthen the Supervision of the Doctor Service Process
Haodaifu online is a intermediate platform to contact the doctor and the patient, if it does not strictly monitor the service process the user's experience will be affected, and the nature of the medical profession is special, so the doctor consultation process is not standardized may cause serious consequences.

Mobile medical industry for the lack of monitoring the main performance in the following two aspects. First, the online consultation cannot guarantee that the doctor involved the consultation himself. Online consultation is different from the traditional diagnose, if the consultation process is monitored non-strictly, phenomenon that doctor assistant or intern instead of the doctor to communicate with users online will happen. Whether the doctor is responsible for consultation, whether to lead the patient to the phenomenon of additional consumption. Whether the doctor is responsible for consultation, whether there is the phenomenon of driving patients to additional consumption. APP operators should carry out the supervision from the online and offline, and establish the feedback complaints mechanism. Strictly monitor the content of online consultation conversations and check frequently. Haodaifu can also set up a monitoring team, and the team members throughout the country, they should often go to the cooperative hospital to patrol. But also be cooperation with the hospital, and the hospital acts as a supervisory role, Haodaifu only need to contact with the hospital to obtain data regularly. At the same time, complaints mechanism can be established, the patient can complain about the behavior of doctors but they should provide evidence.

5. Conclusion
The shortage of medical resources and uneven distribution provide the mobile medical a huge market, mobile medical heat rose again, and the market appears more than two thousand corresponding products. With the exposure of bidding model and Putin, mobile medical industry began to gradually cool, and the user is more calm and rational. Extensive development model has passed, there are so many homogeneous products in the market, if you want to stand out you must enhance the quality of
service and user's experience.

Understanding customer needs, and constantly improving the credit evaluation system is the key task of the development of the industry at this stage. Some measures can be considered to carry out, such as supervising doctors and users’ qualification strictly, improving the credit evaluation indicators and evaluation channels, optimizing the credit index algorithm, strengthening the service process supervision. With reliable quality, perfect supervision mechanism to enhance customer satisfaction, and to reinforce corporate image, while serving the community, the economic efficiency of enterprises can be strengthened.

The industry can also try to build a third-party credit rating agency in the future, which is independent to the mobile medical platform, to create a more objective credit management environment. Everyone in this industry can try to seek more diverse credit evaluation indicators, to break the status that patient get together to the top three hospitals to accept treatment, to tap more quality doctor resources, to decentralize treatment options, and thus the efficiency of medical services can be improved truly.

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7. References
[1] CNNIC.(The 38th China Internet Development Statistics Report) [R]2016.http://www.cnnic.net.cn/hlwzyj/hlwzxbg/hlwtxjb/201608/P020160803367337470363.pdf.
[2] Quest Mobile, 2016 Spring APP List: Total user volume exceeded 927 million, Wechat, QQ, Taobao, MAU ranking the top three [R]2016.http://www.questmobile.com.cn/blog/blog-39.html.
[3] Fanjin. Telemedicine and Internet Medical [EB/OL]. (2015-03-15).[2015-12-23].http://health.sohu.com/20150315/n409815923.shtml.
[4] Quest Mobile What if Medical app better than health app?[R].2016.http://www.questmobile.com.cn/blog/blog_56.html.
[5] Colin F. Camerer, Teck-Hua Ho and Juin Kuan Chong. Behavioral Game Theory: Thinking, Learning and Teaching. Advances in Understanding Strategic Behavior pp 120-180. Palgrave Macmillan UK.2004.http://link.springer.com/book/10.1057/9780230523371.