Author's response to reviews

Title: The effect of health care system reform on cataract surgery and intraocular lens selection in Chongqing, China

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The effect of health care system reform on cataract surgery and intraocular lens selection in Chongqing, China

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Abstract

Background: Cataract is the leading cause of blindness in China, and poverty is the main barrier to accessing cataract surgery. In 2003, the Chinese government began new national healthcare reform which aimed to provide everyone the right to receive and afford medical treatment. In this study, we explore the effect of health care system reform on cataract surgery and intraocular lens (IOLs) selection from 2003 to 2008 in Chongqing, China.

Methods: Medical records of consecutive case series of 14700 eyes of 13262 patients who underwent age-related cataract surgery in 8 hospitals in Chongqing were analyzed retrospectively in each year via multi-stage cluster sampling from January 1, 2003, to December 31, 2008, including total number of operations, medical insurance coverage, cataract surgery method and IOLs selection.

Results: In the past 6 years, whether urban patients or rural patients, the total number of cataract surgery and the proportion of the eyes enjoyed medical insurance gradually increased (p<0.001); The odds ratios of medical insurance between the eyes of urban patients and rural patients were 6.83 (95% CI, 3.83-12.18), 6.93 (95% CI, 4.33-11.09), 6.93 (95% CI, 4.57-10.51), 6.04 (95% CI, 4.46-8.17), 1.96 (95% CI, 1.63-2.37) and 0.47 (95% CI, 0.40-0.54), respectively; The percentage of phacoemulsification (Phaco) and foldable IOLs selection elevated gradually, and the proportion of phaco and foldable IOLs used in medical insurance group was significantly higher than non-medical insurance group in each year (p<0.001). The odds ratios of phaco selection between medical insurance and non-medical insurance groups were 3.51 (95% CI, 2.53-4.88), 3.21 (95% CI, 2.28-4.51), 3.59 (95% CI, 2.46-5.24), 6.79 (95% CI, 5.19-8.88), 7.95 (95% CI, 5.77-10.96) and 11.68 (95% CI, 8.19-16.65), respectively, and the odds ratios of foldable IOLs selection between medical insurance and non-medical insurance groups were 5.95 (95% CI, 4.37-8.09), 5.30 (95% CI, 4.15-6.79), 6.64 (95% CI,
5.28-8.35), 4.90 (95% CI, 4.12-5.82), 5.98 (95% CI, 5.11-7.00) and 3.24 (95% CI, 2.84-3.69), respectively.

**Conclusions:** Patients with medical insurance seemed to have more inclination to accept cataract surgery and choose phaco and foldable IOLs. It indicated that health care system reform was an important influencing factor for patients accepting cataract surgery and selecting cataract surgery method and IOLs in Chongqing. Prevention and treatment of cataract blindness can restore vision with current medical technologies. Due to the economic aspect, cataract blindness is also a social problem, which needs closer attention and more support from the government.
Background

Cataract is the leading cause of blindness in China [1-3]. Currently, there are approximately 2.5 million people with cataract-induced blindness[4], 70% of whom live in rural areas[5]. Poverty is the main barrier to accessing cataract surgery in China. With the promotion of "Vision 2020—the Right to Sight"[6], under the guidance and with the support of China’s Ministry of Health, disabled persons’ federations and non-governmental organizations at home and abroad, significant efforts have been made to improve the accessibility of cataract services in recent years. For example, partial subsidies have been provided by the government, and free operations have been donated by charitable societies. However not everyone who needs cataract surgical treatment can enjoy free or charity operations. The number of patients who need cataract operations remains quite large. So additional measures to improve this situation are urgently needed.

In 2003, the Chinese government began new national healthcare reform. This plan aimed to provide everyone, i.e., all nationals in China, the right to receive and afford medical treatment. The medical system reform consisted of two parts, the new rural cooperative medical scheme which was introduced since 2003 and fully implemented in 2007 aimed at providing insurance to rural residents [7-11], and the urban resident basic medical insurance scheme which began to be introduced in 2007 for urban residents who are not covered by urban employee basic medical insurance.

Does the medical system reform influence patients with cataract? And what will be the effect of health care system reform on cataract surgery? In order to investigate the effect of health care system reform on cataract surgery and IOLs selection, we retrospectively investigated the cataract surgery status of
patients in Chongqing from 2003 to 2008. For Chongqing is one of the first selected points of healthcare system reform in China. It is also the one of four municipalities directly under the central government in China, either medical condition or economic basis in Chongqing is in the middle level in China, with some representativeness, the medical reform in Chongqing could reflect the results of medical reform in China from a side aspect.

Methods

Study sample

In 2003, there were only 12 tertiary hospitals and 10 secondary hospitals which were able to carry out cataract surgeries with implantation of IOLs in Chongqing. This retrospective study, using multi-stage cluster sampling, took place at the four tertiary hospitals and four secondary hospitals in Chongqing, China. The tertiary hospitals were: Daping Hospital of Third Military Medical University, The Second Affiliated Hospital Chongqing Medical University, Wujing Chongqing Zongdui Hospital, and Chongqing Third People's Hospital. The secondary hospitals were: Jiangbei First People's Hospital of Chongqing, Shapingba First People's Hospital of Chongqing, Chongqing Iron and Steel Company General Hospital, and the Staff-worker Hospital of Chongqing Machine Tool Factory. Among the above-mentioned hospitals 6 hospitals located in urban, 2 hospitals located in suburban, accounting for 40% of total number of cataract surgery in 2003 in Chongqing. These cases included in this study possessed sufficient representativeness. The study was approved by the Institutional Review Boards at the participating institutions.

Consecutive case series analysis was applied to collect clinical data from medical records of patients with age-related cataract. Cases included 14,700 eyes of 13,262 patients in the locality who underwent surgical treatment in the above-mentioned hospitals from January 1, 2003 to December 31, 2008. The total number of patients, geographic distribution, medical insurance coverage, cataract surgery method and IOLs selection were retrospectively analyzed for all these cases.

Categories of Cases

Based on medical history information, all cases were designated as urban residents or rural residents,
According to the designated geographic division. Based on the medical insurance status of patients, such as basic medical insurance for urban dwellers, and new rural cooperative medical insurance for rural residents, the cases were divided into two groups: patients with medical insurance and patients without medical insurance. The cataract surgery method included extracapsular cataract extraction (ECCE) which operation patient should pay for 1500 renminbi (US $221) and Phaco which operation patient should pay for 2400 renminbi (US $353) in this study. And only 1500 renminbi (US $221) can be paid for the operation by patients with medical insurance by government. IOLs used in this study included unfoldable IOLs from 450 renminbi (US $66) to 825 renminbi (US $121) and foldable IOLs which could only be implanted by patients accepting phaco, from 1600 renminbi (US $234) to 9600 renminbi (US $1406). And only 450 renminbi (US $66) can be paid for the IOLs selected by patients with medical insurance by government.

**Statistical Analysis**

The data collection forms were developed by a team that included ophthalmologists and epidemiologists. All clinical data of the eyes of age-related cataract patients who underwent surgical treatment in the above-mentioned eight hospitals from 2003 to 2008 were computerized and then rechecked by different staffs. Then, all data were analyzed by chi-square tests with SPSS for Windows Version 13.0 (SPSS Inc, Chicago, IL, USA); p<0.05 was considered statistically significant.

**Results**

In the past six years, the proportion of cataract treatments provided by medical insurance elevated yearly (Figure 1). Whether urban patients or rural patients, the total number of cataract surgeries performed and the proportion of the treatments covered by medical insurance gradually increased. From 2003 to 2007, the proportion of urban patients participating in medical insurance was higher than rural patients. However, the proportion of urban patients with medical insurance was significantly lower than rural patients in 2008 (χ²=566.546, p<0.001). From 2003 to 2008, the odds ratios of medical insurance coverage between the urban patients and rural patients were 6.83 (95% CI, 3.83-12.18), 6.93 (95% CI, 4.33-11.09), 6.93 (95% CI, 4.57-10.51), 6.04 (95% CI, 4.46-8.17), 1.96 (95% CI, 1.63-2.37) and 0.47 (95% CI, 0.40-0.54), respectively (Table 1).
For both urban and rural patients, the proportion of phaco selection increased gradually. The proportion of urban patients who selected phaco was higher, compared to rural patients (Figure 2). The rate of phaco selection was significantly higher in the medical insurance group than in the non-medical insurance group each year. From 2003 to 2008, the odds ratios of phaco selection between medical insurance and non-medical insurance groups were 3.51 (95% CI, 2.53-4.88), 3.21 (95% CI, 2.28-4.51), 3.59 (95% CI, 2.46-5.24), 6.79 (95% CI, 5.19-8.88), 7.95 (95% CI, 5.77-10.96) and 11.68 (95% CI, 8.19-16.65), respectively (Table 2).

For both urban and rural patients, the proportion of foldable IOLs selection increased gradually. The proportion of urban patients who selected foldable IOLs was higher, compared to rural patients (Figure 3). The rate of foldable IOLs selection was significantly higher in the medical insurance group than in the non-medical insurance group each year. From 2003 to 2008, the odds ratios of foldable IOLs selection between medical insurance and non-medical insurance groups were 5.95 (95% CI, 4.37-8.09), 5.30 (95% CI, 4.15-6.79), 6.64 (95% CI, 5.28-8.35), 4.90 (95% CI, 4.12-5.82), 5.98 (95% CI, 5.11-7.00) and 3.24 (95% CI, 2.84-3.69), respectively (Table 3).

**Discussions**

Economic status is an important limiting factor for access to cataract surgery and determines whether or not patients are able to afford cataract surgery as well as which method of cataract surgery and type of IOLs they choose [12-16]. The current study revealed that the total number of cataract surgeries and foldable IOLs selection increased in Chongqing yearly from 2003 to 2008. These findings might be related to the rapid development of the economy[12, 17], the improved health care conditions and elevated patient awareness regarding cataract diagnosis and treatment options[18, 19]. In addition, during this period, the medical health system reform that took place in Chongqing also played an important role.

In 2003 medical system reform was performed in Chongqing, about 1,217,700 urban dwellers took part in medical insurance and 1,089,500 rural residents joined the new rural cooperative medical insurance[20]. In 2008, the total number of urban dwellers who participated in medical insurance reached 2.55 million, and 21.75 million rural residents joined the new rural cooperative medical
insurance. The participation rate of rural residents was 85.3% [21]. The new reforms benefit both urban and rural people by providing increased levels of medical treatment.

Our study revealed that the proportion of the cataract patients who had medical insurance increased year by year. From 2003 to 2007, the proportion of medical insurance-covered patients in urban areas was higher than rural areas, but in 2008, the proportion of rural patients with medical insurance was significantly higher than that of urban patients. For rural patients up to 71.42% had medical insurance, as a result of the full implementation of medical system reform in 2007 combined with a high participation rate for rural residents. In the past six years, the total number of cataract cases increased gradually, and the percentage of patients with medical insurance elevated significantly, suggesting that patients with medical insurance seemed more inclined to accept cataract surgery. From 2003 to 2006, the odds ratios of medical insurance between the eyes of urban patients and rural patients were relatively stable. But it decreased significantly in 2007, and even lower in 2008. This change followed governmental implementation of medical insurance reform in Chongqing, indicating that medical insurance had an important impact on whether patients underwent cataract surgery, especially in the case of rural patients.

Our survey also showed that, each year, more and more cataract patients chose phaco and foldable IOLs. However, the proportion of phaco and foldable IOLs selection by rural residents was lower than urban dwellers because of their economic conditions. Moreover, phaco and foldable IOLs were selected more often by patients with medical insurance. Due to a significant increase in the proportion of rural patients with medical insurance in 2008, though the odds ratio of phaco selection between patients in the medical insurance and non-medical insurance groups increased significantly for better restoration for acuity vision, the odds ratio of foldable IOLs selection declined slightly for economic barrier, compared with previous years. This change followed governmental action on medical insurance reform in Chongqing, indicating that medical insurance was an important factor impacting choice of cataract surgery method and IOLs type.

This study has several limitations. Most of hospitals in our survey were located in the Chongqing metropolitan area, so in our study rural patients were smaller than urban patients. And percentage of phaco
and foldable IOLs in rural patients was perhaps lower than our estimates. But the tendency of percentage of phaco and foldable IOLs chose by rural patients is increased. Furthermore, these findings could be even more pronounced in other more developed regions in China. These limitations in both survey method and content should be addressed in future survey design to allow us to further tackle the questions around health insurance and outcomes among patients with cataract in China.

**Conclusions**

Our survey found that patients with medical insurance were more inclined to accept cataract surgery and choose phaco and foldable IOLs. It indicated that health care system reform was an important factor influencing patients to have cataract surgery and to select cataract surgery method and IOLs in Chongqing. Prevention and treatment of cataract blindness can restore vision with current medical technologies. Due to the economic aspect, cataract blindness is also a social problem, which needs closer attention and more support from the government. As health care has become more accessible, patients have embraced more advanced and more expensive treatments. This behavior in China has implication in general for health care planning throughout the world.

**Competing interests**

The authors declare that they have no competing interests.

**Authors' contributions**

XFC, CLC and YJ designed and supervised the study, and provided statistical advice throughout the study, XFC analyzed and interpreted data, and drafted the manuscript and finalized writing it, YZ and RDY revised the article. All authors read and approved the final version of the manuscript.

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References


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**Figures**

**Figure 1.** The percentage of medical insurance and non-medical insurance distribution of the eyes.
Figure 2. The percentage of phaco selected by urban and rural patients

Figure 3. The percentage of foldable IOLs selected by urban and rural patients

Tables

Table 1. Medical insurance of cataract patients
### Table 2. The effects of medical insurance on selection of cataract surgery method

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Operations</th>
<th>Medical Insurance</th>
<th>Non-Medical Insurance</th>
<th>OR (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Operations</td>
<td>Phaco (%)</td>
<td>Foldable (%)</td>
<td>Total Operations</td>
<td>Phaco (%)</td>
</tr>
<tr>
<td>2003</td>
<td>1264</td>
<td>410 (36.26)</td>
<td>854 (67.21)</td>
<td>3.51 (2.53-4.88)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2004</td>
<td>1644</td>
<td>576 (39.4)</td>
<td>1068 (79.03)</td>
<td>3.21 (2.28-4.51)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2005</td>
<td>1807</td>
<td>658 (41.42)</td>
<td>1149 (83.64)</td>
<td>3.59 (2.46-5.24)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2006</td>
<td>2678</td>
<td>1014 (43.3)</td>
<td>1664 (67.55)</td>
<td>6.79 (5.19-8.88)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2007</td>
<td>3153</td>
<td>1330 (45.3)</td>
<td>1823 (78.99)</td>
<td>7.95 (5.77-10.96)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2008</td>
<td>4154</td>
<td>2432 (53.86)</td>
<td>1722 (85.08)</td>
<td>11.68 (8.19-16.65)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Phaco = phacoemulsification; OR = odds ratios; CI = confidence interval

### Table 3. The effects of medical insurance on IOLs selection

<table>
<thead>
<tr>
<th>Year</th>
<th>Total IOLs</th>
<th>Medical Insurance</th>
<th>Non-Medical Insurance</th>
<th>OR (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total IOLs</td>
<td>Foldable (%)</td>
<td>Non-Foldable (%)</td>
<td>Total IOLs</td>
<td>Foldable (%)</td>
</tr>
<tr>
<td>2003</td>
<td>1175</td>
<td>378 (40.21)</td>
<td>797 (10.16)</td>
<td>5.95 (4.37-8.09)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2004</td>
<td>1547</td>
<td>540 (45.93)</td>
<td>1007 (13.80)</td>
<td>5.30 (4.15-6.79)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2005</td>
<td>1708</td>
<td>624 (54.83)</td>
<td>1084 (14.94)</td>
<td>6.64 (5.28-8.35)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2006</td>
<td>2599</td>
<td>983 (58.49)</td>
<td>1616 (22.34)</td>
<td>4.90 (4.12-5.82)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2007</td>
<td>3089</td>
<td>1295 (66.56)</td>
<td>1794 (24.97)</td>
<td>5.98 (5.11-7.00)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2008</td>
<td>4097</td>
<td>2399 (60.65)</td>
<td>1698 (32.27)</td>
<td>3.24 (2.84-3.69)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

IOLs = intraocular lens; OR = odds ratios; CI = confidence interval