Comparison of Health Care Utilization Among Patients Affiliated and Not Affiliated with Healthcare Professionals in China

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Abstract

**Background:** Doing “more” in healthcare can be a major threat to the delivery of high-quality healthcare. It is important to identify the supplier-induced demand of healthcare. This study aims to test supplier-induced demand theory by comparing health care utilization among patients affiliated with healthcare professionals and their counterpart patients not affiliated with healthcare professionals.

**Methods:** Using cross-sectional data of the China Labour-force Dynamics Survey (CLDS) implemented in 2014, we identified 806 patients affiliated with healthcare professionals and 22788 patients not affiliated with healthcare professionals. We used the coarsened exact matching method to control for confounding factors. The main outcomes were outpatient rate and expenditure as well as inpatient rate and expenditure.

**Results:** The matched outpatient rate of patients not affiliated with healthcare professionals was 0.6% higher (P = .75) than that of their counterparts, and the matched inpatient rate was 1.1% lower (P = .17). Patients not affiliated with healthcare professionals paid significantly more (680 CNY, P < .001) than their counterpart patients did per outpatient visit (1126 CNY [95% CI 885–1368] VS 446 CNY [95% CI 248–643]), while they paid 2,061 CNY insignificant less per inpatient visit (P = .75).

**Conclusion:** Our results lend support on supplier-induced demand hypothesis and highlight the need for policies to address the large outpatient care expenses of patients not affiliated with healthcare professionals. Creating incentives for providers to offer less avoidable healthcare service during outpatient visits may work to reduce healthcare costs.

**Introduction**

In the health care setting, “more” is not always better. Instead, doing “more” can be a major threat to the delivery of high-quality health care.\(^1\) Increasing concerns have arisen about provider misbehavior because of their advantage of medical information and distorted financial incentives to provide costlier but unnecessary care, namely supplier-induced demand (SID), which is not aimed at improving health and general well-being of patients.\(^2-4\)

Supplier-induced demand leads to overuse of healthcare, which is defined as the provision of health services that patients would not need or reject if they had full information or were fully informed.\(^2-4\)
Several methods have been advised to identify SID in health care. First, variation in physician income was used to test for induced behavior by examining the association between physicians competition and healthcare utilization, and it was hypothesized that more intense competition would lead to fewer patients and hence an increase in SID.\textsuperscript{5–11} Second, changes in physician fees were used to identify SID, mostly based on the target income hypothesis.\textsuperscript{12–15} Finally, variation in patient information is important to test SID by identifying the effect of medical information on health care utilization. These studies suggest that medical information and physician incentives are important determinants of health care demand and health care expenditure. However, more work is needed before we can conclude about the economic importance of SID.

Acquiring sufficient medical information allows patients to comprehend health care service and make informed choices while healthcare professionals would induce patients to use more by providing recommendations.\textsuperscript{16–18} However, as for themselves, well-trained healthcare professionals well understand the problems they are looking to resolve; they can be aware of all potential medications for treatment and their potential side effects; they are regarded as the most informed patients.\textsuperscript{19,20} As the most informed patients, designating consumption of healthcare professionals as the gold standard does not imply that this is the proper standard for appropriate and effective healthcare.\textsuperscript{4,17,20} However, their demand for health care can be an important benchmark to judge SID in the absence of well-established cost-benefit or risk-benefit analysis to assess the value of health care services.

A study in \textit{NEJM} in 1974 firstly compared surgery rates for lawyers, businessmen, and ministers with those of physicians and found self-reported surgery rates to be equal or higher among healthcare professionals.\textsuperscript{21} The same approach using survey data was adopted with more extensive controls, including income, insurance coverage, and self-reported health status, but they also find higher use among healthcare professionals.\textsuperscript{2} In a more recent survey in Switzerland, healthcare professionals have much lower surgery rates than did the general population.\textsuperscript{20} Less health service is provided to
healthcare professionals than to others who lack the same medical knowledge but have similar healthcare demand and socioeconomic status.\textsuperscript{2,20–22} China unveiled its ambitious health system reform with the goal of providing affordable and equitable basic health care coverage for all by 2020.\textsuperscript{23} However, much of the government spending, health insurance funds, and out-of-pocket health care expenditure are likely captured by providers in the form of higher income and profits if the core culprit of rapidly increasing health care expenditure is the predominant fee-for-service payment system in China as well as other countries worldwide, driven by the overuse of examinations and drugs.\textsuperscript{23–25} Empirical evidence of SID is difficult to obtain but crucial to advance health policy. We attempt to contribute to the literature by comparing the healthcare utilization among patients affiliated and not affiliated with healthcare professionals in China using national representative data.

\textbf{Methods}

\textbf{Overview}

This study, conducted from May 2017 to December 2017, was approved by the Health Science Center Ethics Committee at Xi’an Jiaotong University, Shaanxi, China (approval number: 2015–644). The requirement for informed consent was waived because participation involved no more than minimal risk to the study participants. The confidentiality of individual practices has been protected. This study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for cross-sectional studies.

\textbf{Data}

The data was drawn from the China Labor-force Dynamics Survey (CLDS) conducted in 2014. CLDS is an open-access database and the first national longitudinal social survey targeted at the labor force in China, covering a series of topics, such as demographic characteristics, family, education, employment, work history, income, migration, and health (http://css.sysu.edu.cn/).\textsuperscript{26,27} A multistage stratified cluster random sampling method was used, and the subjects of CLDS are the laborers (all family members aged 15–64) randomly selected from 29 provinces in China. The survey is conducted every two years and has accumulated three waves of data now (2012, 2014, and 2016). All
investigators were trained before investigation and were monitored during the investigation. Computer-assisted personal interviewing (CAPI) technology was adopted to control data quality. The study was performed in 2017, and thus we used the available 2014 wave for analysis, in which more than 800 investigators collected 401 village questionnaires, 14214 family questionnaires and 23594 individual questionnaires.

Occupation information of each family member was collected in CLDS, and the occupation was classified using code in the fifth National Census. By following previous studies and enlarging the sample size, we included all healthcare professionals for our analysis and defined affiliated individuals as there is any family member is healthcare professional (Appendix1). Not affiliated individuals were defined as no family member is healthcare professional. Finally, we identified 806 individuals affiliated with healthcare professionals and 22,788 individuals not affiliated with healthcare professionals for further analysis.

Outcome variables and covariates
The CLDS collected information on outpatient use in the last two weeks and inpatient use in the last year to measure health care utilization to avoid the recall bias in retrospective investigation. Therefore, we generated four outcome variables, outpatient rate, outpatient expenditure, inpatient rate, and inpatient expenditure, for analysis. A series of socio-demographic variables that might affect demand for health care utilization were considered for inclusion in the matching. The variables were chosen based on a literature review and data availability, including a health status indicator, coverage of health insurance, living in urban or rural areas, age, gender, educational attainment, and economic status, in the matching for health care utilization.

Coarsened Exact Matching
We employed coarsened exact matching (CEM) to better balance distributions of the covariates between the comparison groups and thereby reduce biases. A key property of CEM, comparing with propensity score matching (PSM), is that CEM fixes the maximum imbalance through an ex ante choice specified by the user; i.e., the user decides how the observed characteristics are to be coarsened. The user does not need to further conduct balance checking or restrict data to common
support as required by PSM. The matching approach helped to identify the counterparts for patients not affiliated with healthcare professionals, based upon the observable pre-treatment characteristics. The above covariates were included in matching and we further included the hospital tier in the matching for per-outpatient expenditure and the hospital tier and inpatient reason in the matching for yearly inpatient expenditure. Overall, we carried out three coarsened exact matching processes in the study. We used 2-tailed tests and a significance threshold of $P < .05$. All analyses were performed in Stata version 13.0 (Stata Corp LP, College Station, Texas, USA).

Results

In the study, there are 806 patients affiliated with healthcare professionals and 22788 patients not affiliated and the basic information of their characteristics is showed in Table 1. In Table 2, almost 4.8% (95% CI, 4.5% to 5.0%) of patients not affiliated with healthcare professionals used outpatient care in the last two weeks, a little higher than that for patients affiliated with healthcare professionals, i.e. 4.7% (95% CI, 3.3% to 6.2%). Meanwhile, 5.80% (95% CI, 5.5% to 6.1%) of patients not affiliated with healthcare professionals utilized inpatient care in the past year, a figure lower than 6.1% (95% CI, 4.4% to 7.7%) for patients affiliated. Furthermore, outpatient expenditure per visit for patients not affiliated with healthcare professionals is 1200 CNY (95% CI, 1034 to 1367), much higher than 479.4 CNY (95% CI, 278 to 681) for patients affiliated. However, yearly average inpatient expenditure for patients not affiliated with healthcare professionals is 13,172 CNY (95% CI, 11580 to 14765), which is lower than 15,256 CNY (95% CI, 6634 to 23878) for patients affiliated.

Table 1

| Variables     | Definition             | Affiliated | Not affiliated | Overall |
|---------------|------------------------|------------|----------------|---------|
|               |                        | N          | %              | N       | %       | N       | %       |
| Economic status a | Log expenditure, mean (S.D.) | 9.4 (1.0) | 9.1 (1.0)      | 9.1 (1.0) |
| Gender        | Male                   | 440        | 54.6           | 11830   | 51.9    | 12270   | 52.0    |
|               | Female                 | 366        | 45.4           | 10957   | 48.1    | 11323   | 48.0    |
| Age           | >=60                   | 694        | 88.6           | 19010   | 87.5    | 19704   | 87.5    |
|                        | <60 | 11.4 | 2726 | 12.5 | 2815 | 12.5 |
|------------------------|-----|------|------|------|------|------|
| Health status          |     |      |      |      |      |      |
| Health                 | 270 | 33.5 | 8697 | 38.2 | 8967 | 38.0 |
| Fair/Unhealthy         | 536 | 66.5 | 14090| 61.8 | 14626| 62.0 |
| Insurance              |     |      |      |      |      |      |
| Insured                | 568 | 85.5 | 17083| 92.8 | 17651| 92.6 |
| Uninsured              | 96  | 14.5 | 1321 | 7.2  | 1417 | 7.4  |
| Urban                  |     |      |      |      |      |      |
| Rural                  | 306 | 38.0 | 14126| 62.0 | 14432| 61.2 |
| Urban                  | 500 | 62.0 | 8662 | 38.0 | 9162 | 38.8 |
| Access a               |     |      |      |      |      |      |
| Log time, mean (S.D.)  | 1.8 | (0.8)| 1.9  | (0.8)| 1.9  | (0.8)|
| Education              |     |      |      |      |      |      |
| Illiteracy             | 150 | 18.7 | 8351 | 36.8 | 8501 | 36.1 |
| Primary school         | 195 | 24.3 | 7545 | 33.2 | 7740 | 32.9 |
| Middle school          | 197 | 24.5 | 3974 | 17.5 | 4171 | 17.7 |
| High school and above  | 261 | 32.5 | 2854 | 12.6 | 3115 | 13.2 |
| Outpatient level b     |     |      |      |      |      |      |
| Primary c              | 23  | 60.5 | 725  | 67.1 | 748  | 66.9 |
| Non-primary            | 15  | 39.5 | 355  | 32.9 | 370  | 33.1 |
| Inpatient level b      |     |      |      |      |      |      |
| Primary d              | 11  | 22.9 | 302  | 23.1 | 313  | 23.1 |
| Secondary              | 34  | 70.8 | 924  | 70.6 | 958  | 70.6 |
| Tertiary               | 3   | 6.3  | 83   | 6.3  | 86   | 6.3  |
| Inpatient reason b     |     |      |      |      |      |      |
| Else                   | 4   | 8.3  | 90   | 6.9  | 94   | 6.9  |
| Disease                | 34  | 70.8 | 977  | 74.6 | 1011 | 74.5 |
| Rehabilitation         | 6   | 12.5 | 158  | 12.1 | 164  | 12.1 |
Fertility  4  8.3  84  6.4  88  6.5

a Economic status is the natural logarithm of household consumption expenditure per capita per year;
Access is the natural logarithm of time to go to the nearest medical institution (minutes).
b Individuals having outpatient visit or inpatient visit are summarized with outpatient level, inpatient level and inpatient reason.
c Primary hospital for out visit includes village clinic/private clinic, township hospital and community healthcare center, while non-primary hospital for out visit includes the second level hospitals and above.
d Primary hospital for in visit includes village clinic/private clinic, township hospital and community healthcare center.

Table 2
Health care utilization and expenditure before matching

| Outcomes                  | Group       | N   | %   | 95% Confidence Interval | Lower | Upper |
|---------------------------|-------------|-----|-----|-------------------------|-------|-------|
|                           |             |     |     |                         |       |       |
|                           | Affiliated  | 806 | 4.7 | 3.3                     | 5.3   | 6.2   |
|                           | Not affiliated | 22788 | 4.8 | 4.5                     | 5.0   |       |
| Outpatient visit          | Affiliated  | 806 | 6.1 | 4.4                     | 7.7   |       |
|                           | Not affiliated | 22788 | 5.8 | 5.5                     | 6.1   |       |
| Inpatient visit           | Affiliated  | 806 | 6.1 | 4.4                     | 7.7   |       |
|                           | Not affiliated | 22788 | 5.8 | 5.5                     | 6.1   |       |
| Outpatient expenditure, mean (S.D.) | Affiliated | 479 | 613 | 278                     | 681   |       |
|                           | Not affiliated | 1200 | 2773 | 1034                   | 1367  |       |
| Inpatient expenditure, mean (S.D.) | Affiliated | 15256 | 29693 | 6634                  | 23878 |       |
|                           | Not affiliated | 13172 | 29365 | 11580                 | 14765 |       |

In Table 3, we find that gender and living in the urban/rural areas would affect outpatient and inpatient health care utilization of patients not affiliated with healthcare professionals (P<.001) but not patients affiliated (P = .93). Educational attainments would affect outpatients and inpatients health care utilization of patients not affiliated with healthcare professionals (P<.001, P<.001).

However, education attainments would affect inpatients health care utilization (P = .06) but not outpatient health care utilization of patients affiliated (P = .29). Health status significantly affects outpatient health care utilization (P<.001, P<.001) and inpatient health care utilization (P<.001, P<.001) of both patients affiliated and not affiliated with healthcare professionals. Finally, fewer socio-demographic factors would affect health care expenditure of the two groups.
Table 3
Comparing health care utilization and expenditure across socio-demographic groups

| Variables                  | Outpatient visit (%) | Inpatient visit (%) | Outpatient expenditure (CNY), mean (S.D.) | Inpatient expenditure (CNY), mean (S.D.) |
|----------------------------|----------------------|---------------------|------------------------------------------|------------------------------------------|
|                            | Not affiliated       | Affiliated          | Not affiliated                           | Affiliated                               |
| Gender                     |                      |                     |                                          |                                          |
| Female                     | 5.3                  | 4.8                 | 6.5                                      | 6.6                                      | 1900 (8286) | 421 (636) | 12588 (3042) | 13464 (2997) |
| Male                       | 4.2                  | 4.6                 | 5.1                                      | 5.5                                      | 2196 (6875) | 552 (595) | 13976 (2784) | 17765 (2988) |
| p-value, a, b              | <.001                | <.001               | .51                                      | .53                                      | .52         | .40       | .63         |                     |
| Education                  |                      |                     |                                          |                                          |
| Illiteracy                 | 6.4                  | 6.0                 | 7.9                                      | 9.3                                      | 1546 (6487) | 547 (845) | 12809 (3274) | 10531 (2157) |
| Primary school             | 4.2                  | 6.7                 | 5.3                                      | 6.7                                      | 2593 (8408) | 565 (458) | 13149 (2573) | 19000 (3279) |
| Middle school              | 3.7                  | 3.6                 | 4.5                                      | 7.1                                      | 1631 (4930) | 140 (198) | 13711 (2416) | 20900 (3998) |
| High school and above      | 2.9                  | 3.5                 | 2.9                                      | 3.1                                      | 3481 (13552) | 603 (778) | 15330 (2786) | 6738 (4037)   |
| p-value                    | <.001                | <.001               | .06                                      | .07                                      | .38         | .90       | .65         |                     |
| Age                        |                      |                     |                                          |                                          |            |          |            |                     |
| <60                        | 4.6                  | 4.6                 | 5.1                                      | 5.8                                      | 1886 (6980) | 439 (619) | 12486 (2257) | 14679 (2780) |
| >=60                       | 6.1                  | 6.7                 | 9.8                                      | 9.0                                      | 2855 (11250)| 698 (582) | 17570 (4841) | 19912 (4080) |
| p-value                    | .001                 | .38                 | <.001                                    | .23                                      | .14         | .35       | .02         | .66           |
| Health                     |                      |                     |                                          |                                          |
| Fair/Unhealthy             | 9.1                  | 10.0                | 11.2                                    | 10.7                                    | 2243 (8115) | 545 (670) | 14971 (3316) | 19768 (3772) |
| Health                     | 2.1                  | 2.1                 | 2.5                                      | 3.7                                      | 1440 (6484) | 338 (460) | 8206 (1316)  | 8940 (9297)  |
| p-value                    | <.001                | <.001               | <.001                                    | .13                                      | .34         | <.001     | .22         |                     |
| Insurance                  |                      |                     |                                          |                                          |
| No                         | 5.1                  | 5.5                 | 6.6                                      | 6.2                                      | 2023 (7365) | 488 (599) | 13357 (3024) | 17583 (3354) |
| Yes                        | 5.2                  | 3.1                 | 5.1                                      | 7.3                                      | 2653 (12229)| 380 (539) | 15737 (2606) | 7000 (4637)  |
| p-value                    | .88                  | .34                 | .03                                      | .67                                      | .52         | .77       | .53         | .49           |
| Urban                      |                      |                     |                                          |                                          |
| Rural                      | 5.2                  | 5.2                 | 6.2                                      | 6.2                                      | 1642 (6651) | 566 (633) | 12007 (3025) | 12172 (1866) |
| Urban                      | 4.0                  | 4.4                 | 5.2                                      | 6.0                                      | 2823 (9512) | 416 (605) | 15489 (2739) | 17107 (3485) |
| p-value                    | <.001                | .59                 | .001                                     | .90                                      | .02         | .47       | .04         | .58           |

a Chi-2 test was used for dummy variable.

b Univariate ANOVAs was employed for continuous variables.

Through coarsened exact matching, we compare health care utilization and expenditure between the two groups. After the matching, 7722 patients not affiliated with healthcare professionals and 677 patients affiliated were identified for further analysis in health care utilization, 387 patients not affiliated with healthcare professionals and 32 patients affiliated were identified for further analysis in per-outpatient expenditure, and 195 patients not affiliated with healthcare professionals and 31
patients affiliated were identified for further analysis in yearly inpatient expenditure. The balance check (Appendix 2) is reported to confirm that there is no statistical significance between the two groups. Figure 1 indicates that the outpatient rate of patients not affiliated with healthcare professionals is 0.63% (P = .75) higher than that of patients affiliated (4.3% [95% CI 3.9–4.8] VS 3.7% [95% CI 2.3–5.1]), while the inpatient rate of patients not affiliated with healthcare professionals is 1.11% (P = .17) lower than that of patients affiliated (4.2% [95% CI 3.7–4.6] VS 5.3% [95% CI 3.6–7.0]), but the differences are not statistically significant. Moreover, patients not affiliated with healthcare professionals paid significantly more (680 CNY, P<.001) than patients affiliated did per outpatient visit (1126 CNY [95% CI 885–1368] VS 446 CNY [95% CI 248–643]). However, patients not affiliated with healthcare professionals paid less (2061 CNY, P = .75) than patients affiliated did in the last year but with no statistical significance (15584 CNY [95% CI 12052–19115] VS 17645 CNY [95% CI 4884–30406]).

Discussion
Healthcare professionals are often blamed for the high cost of health care services as they are often able to induce patients to consume more health care than necessary. For instance, studies have illustrated that physicians tend to perform more cesarean delivery in response to declining fertility, treat more intensively when their incomes are adversely affected by fee-reduction policies, and prescribe more medications to patients. As a key part of health literacy, medical information helps patients understand health care service to make more informed choices. Health literacy concerns the knowledge and competences for people to make complex health decisions, and has received special attention in recent years. Health literacy has been found associated with improved self-reported health, lower healthcare costs, more healthcare knowledge, shorter hospitalization, and reduced health care service use. Therefore, everything else equal, patients affiliated with healthcare professionals may use less healthcare and incur lower healthcare costs than patients not affiliated.

Research on health care service consumption by physician-patients is scarce, though healthcare
professionals may best recognize risks and benefits of health care service. Compared with existing literature, we employ large-scale national representative data. In addition, our defined medical information provision allows diffusion within household, which enables us to consider the fact that informed individuals often help their household members make better health care decisions. Finally, we examine SID in the largest developed county as compared to most previous studies in developed countries. By measuring the differences in outcomes among patients affiliated and not affiliated with healthcare professionals, this approach provides a direct channel to estimate SID.

Based on the otherwise similar demand for health care between the two groups, we compare their healthcare expenditure. The patients not affiliated with healthcare professionals paid significantly more (680 CNY) per outpatient visit, accounting for 56.7% of their average outpatient expenditure per visit. However, patients not affiliated with healthcare professionals paid less (2061 CNY) than affiliated patients did in inpatient healthcare in the past year, though the difference is not statistically significant. There is little statistical difference in outpatient or inpatient rates between patients affiliated and those not affiliated with healthcare professionals. Overall, our finding of sizable gap in outpatient spending implies overuse of health care services and likely some extent of SID in outpatient care in China.

There are some plausible explanations for our seemingly conflicting findings between outpatient spending and inpatient spending. First, inpatient expenditure is measured as the total expenditure of inpatient health care in the past year, rather than the per-inpatient expenditure. Patients affiliated with healthcare professionals have a higher inpatient rate than that of patients not affiliated, which may contribute to their higher total inpatient expenditure. Second, the total inpatient expenditure is usually positively associated with the number of inpatient healthcare service. Therefore, predicted higher numbers of inpatient use in patients affiliated with healthcare professionals could have led to the higher inpatient expenditure in the last year. Third, it is possible that patients not affiliated with healthcare professionals would mobilize their social resources or capital to seek health care in China. More studies are needed to investigate this. 39-41

Our study has been carried out in China where healthcare professionals are paid on a fee-for-service
basis and where financial budget constraints prevent residents from obtaining basic health care.\textsuperscript{25,42,43} Recently, China advanced significantly to address problems of unaffordable coverage and illness-associated impoverishment by offering substantial public funding.\textsuperscript{23,24} However, considering the significant effect of SID on the outpatient health care, incentivizing physicians to provide less avoidable care may reduce healthcare costs in China. Our study suggests that the demand of health care may sustain as the public becomes more informed while the health care expenditure of outpatient may decrease sharply. Recognizing the effect of medical information on health, researchers have been focusing on the development of cost-effective interventions to improve health literacy or to limit the problems posed by low health literacy. Previous studies indicated that the overall level of health literacy among Chinese residents was relatively low.\textsuperscript{44} Therefore, health promotion and education may play an important role in patient empowerment, which in turn lead to better self-management of medical conditions, ultimately lowering costs of care.\textsuperscript{28,44,45}

Limitations
The major concern of this study is that even in the same hospital, healthcare professionals working in different departments acquired different medical information, which may create significant information barriers among them and fail our approach of physician-patients. This is well truth with advances in clinical diagnoses and treatment technologies leaving healthcare professionals more specialized. However, differences in medical information does not invalidate the approach for several reasons. First, information often flows efficiently and spills over across departments in the same hospital as healthcare professionals work in a shared environment. Second, most cross-cultural comparisons in the management literature illustrate that the Chinese, including hospital personnel, are collectivists with respect to their working motivation, and achieve personal goals by working with members of their ego-centered trust networks.\textsuperscript{39–41,46} Finally, healthcare professionals and their family members have to interact in repeated games to maximize their own benefits, which gradually forms a cooperative game.\textsuperscript{47,48} Therefore, information spillover, health literacy with patient empowerment, favoritism exchanges, and cooperative games altogether validate the advantage of
healthcare professionals to provide appropriate services for their affiliated patients.

In this study, our sample was large enough to give informative estimates by comparing the use of health care of the two groups delivered by providers; however, a larger sample would make these estimates more precise and possibly a multilevel statistical analysis would provide more insights with larger sample size. The observations of CLDS are labors, who generally have a lower outpatient rate and inpatient rate compared with the old and children, and thus we have a slightly smaller sample size to compare their healthcare expenditure after the matching. Second, the results cannot be interpreted as causal effect regarding the cross-sectional study design. Ideally, more precise estimation of SID should involve direct comparison of the two groups infected with the same disease. Preventable ambulatory or emergency department visit, or preventable hospitalization maybe better for the surrogate of SID related health utilization. Importantly, more socio-demographic analysis can be performed with a larger sample size to quantify the cost differences. Variations in age, health insurance coverage, public/private hospital, and geographical area should also be further addressed in future work.

Conclusion
Patients not affiliated with healthcare professionals have nearly equal demand compared with patients affiliated with healthcare professionals. However, we find that the outpatient expenditure of patients not affiliated with healthcare professionals exhibited a significant higher (680 CNY, or on average 56.7% of outpatient expenditure) per-outpatient health care expenditure than their counterpart group. Our findings support the supplier-induced hypothesis and highlight the need to better understand the rapidly rising health care expenditure in China, a driver of overuse of healthcare due to SID. China must reform its incentive structures for healthcare providers, improve the governance of hospitals, and institute a stronger regulatory system. The gap in outpatient care expenditure in China is large, and creating incentives among physicians to provide less care may work well to reduce healthcare costs. Our study also suggests that as the public becomes more informed, the demand of health care may persist while healthcare expenditure per outpatient visit may decrease sharply due to the decline in supplier-induced demand. Therefore, providing requisite
medical information and promoting health education patients is important for lowering costs of healthcare.

**Declaration**

**Author Contributions:**
Si had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study concept and design:** Si, Su, Zhou, Chen.

**Acquisition, analysis, or interpretation of data:** Si, Su, Yang.

**Drafting of the manuscript:** Si.

**Critical revision of the manuscript for important intellectual content:** Zhou, Su, Hu, Yang, Chen.

**Statistical analysis:** Si, Su, Zhou, Chen.

**Obtained funding:** Zhou, Chen.

**Study supervision:** Zhou, Chen.

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Figures
Comparison of health care utilization and expenditure among patients affiliated and not affiliated with healthcare professionals a Coarsened exact matching was used including health status indicator, health insurance, living in the urban or rural area, age, gender, educational level and economic status in the matching for health care utilization. b Outpatient level was further added in the matching for per-outpatient expenditure. c Inpatient level and inpatient reason were further added in the matching for yearly inpatient expenditure. d p<.001

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