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# BMJ Open

## Defensive Medicine in Obstetrics and Gynecology in China

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Manuscripts

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3 **Defensive Medicine in Obstetrics and Gynecology in China**  
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21 **Keywords:** defensive medicine, lawsuit, cesarean section.  
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3 **Objective:** The study aimed to determine prevalence, patterns, and risk factors of defensive  
4 medicine by obstetricians and gynecologists across China.

5 **Design:** This is a questionnaire survey by written and online interview for participants. The  
6 questionnaire consists of 25 items.

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8 **Participants:** Among 1804 registered physicians participating the 2017 Congress of Chinese  
9 Obstetricians and Gynecologists Association in Chengdu City, Sichuan Province, China, from  
10 August 17 to 20, 2017, 1486 participants (82.4%) responded the survey, with mean age of  
11 41.1±8.2 years.

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13 **Main outcome measures:** Participants' strongly disagreed/disagreed and strongly  
14 agreed/agreed options were compared to determine specific factors contributing to their  
15 preferences about defensive medicine.

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17 **Results:** In the whole cohort, 903 (60.8%), 283 (19.0%), and 170 (60.1%) participants had  
18 experienced at least one medical dispute, lawsuit, or loss of a lawsuit, respectively; and 1284  
19 (86.4%) participants had witnessed their colleagues exposed to medical disputes, lawsuits, or  
20 loss of a lawsuit. Generally, 62.9% of the participants strongly agreed or agreed with practicing  
21 defensive medicine, but there were different or even opposite preferences about specific items  
22 of defensive medicine. Gender, administration duty, employment hospital, education status,  
23 subspecialty, exposure to any medical disputes, lawsuits, or loss of a lawsuit, and colleagues'  
24 experiences were independent risk factors relevant to participants' preferences about  
25 defensive medicine in a multivariate model. In general, participants were more prone to accept  
26 or endorse defensive medicine if they were female physicians; without administrative duties;  
27 working in non-tertiary hospitals; with an undergraduate degree; with any exposure to medical  
28 disputes, lawsuits, or loss of a lawsuit; and having witnessed colleagues' similar exposure.

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30 **Conclusions:** About two-thirds of Chinese physicians practicing obstetrics and gynecology in  
31 our survey agreed with defensive medicine but had differentiated preferences and  
32 understanding of specific practices and harms of defensive medicine and physician's roles.  
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#### 37 **Strengths and limitations of this study**

- 38 ● As to our knowledge this is first report about defensive medicine in a large cohort of  
39 Chinese physicians with high correspondence rate.
- 40 ● We acquired practical data about Chinese physicians' preference in deciding strategies of  
41 diagnosis and treatment, which would provide foundations for further analysis of health  
42 economics of defensive medicine.
- 43 ● The main drawback of our study is inadequate validation of the questionnaire, which had  
44 negative impact on the credibility and repeatability. As in a questionnaire survey, there  
45 inevitable recall bias from participants.  
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## INTRODUCTION

The concept of defensive medicine appeared in 1978<sup>1</sup>, and is now defined as “medical actions performed mainly to prevent being sued rather than actually to aid the patient” by the U.S. Congress’s Office of Technology Assessment<sup>2</sup>. Defensive medicine is also one of the Mesh terms of PubMed, “the alterations of modes of medical practice, induced by the threat of liability, for the principal purposes of forestalling lawsuits by patients as well as providing good legal defense in the event that such lawsuits are instituted.”<sup>3</sup> Concerns and perceptions about medical liability lead practitioners to practice defensive medicine. In a national survey of neurosurgeons, 69% participants strongly agreed or agreed with “I view every patient as a potential lawsuit.”<sup>4</sup> As a result, diagnostic testing, consultations, and imaging studies are ordered to satisfy a perceived legal risk, resulting in higher healthcare expenditures. According to the report by the Institute of Medicine, the lower-bound totals of estimates of excess expenditures identified from workshop discussions would amount to about \$765 billion in 2009, of which the costs of defensive medicine were estimated to be \$210 billion<sup>5</sup>. In the report by Jackson Healthcare, physicians attributed 34% of overall healthcare costs to defensive medicine. Among physicians who reported practicing defensive medicine, an estimated 35% of diagnostic tests, 29% of lab tests, 19% of hospitalizations, 14% of prescriptions, and 8% of surgeries were ordered to avoid lawsuits<sup>6</sup>. As reported, emergency room, primary care, and OB/GYN physicians are most likely to practice defensive medicine<sup>6</sup>. However, little is known about the prevalence and characteristics of defensive medicine by OB/GYN physicians. In the 2017 Congress of Chinese Obstetricians and Gynecologists Association, we initiated a questionnaire survey among registered physicians of obstetrics and gynecology to analyze prevalence, patterns, and risk factors of practicing and endorsing defensive medicine.

## METHODS

### Design

At the 2017 Congress of Chinese Obstetricians and Gynecologists Association in Chengdu City, Sichuan Province, China, from August 17 to 20, 2017, at check-in reception of the Congress, we sent out printed and on-line questionnaires to every participant, and asked for on-site retrieve to ensure proper corresponding rate. For printed questionnaires, we also collected questionnaire on the next day on the opening ceremony, or by mail of paid postage from participants who couldn’t fillout the form in time. On-line questionnaire were sent out by social media of WeChat and data were retrieved by background database. All questionnaires were check by Dr L Li and Dr L Zhu. Data were included only if all items were specified addressed. The Institutional Review Board of PUMCH had approved this study.

### Questionnaire

The questionnaire was constructed by Lei Li and Lan Zhu. For validation, a preliminary study was conducted among 50 physicians of Department of Obstetrics and Gynecology in PUMCH. After discussion, the final version of questionnaire was approved. None of the 50 physicians validating the questionnaire participated in the study.

There is a brief, clear, and neutral introduction about the definition, origin, and prevalence of defensive medicine at the beginning of the questionnaire, which then consists of 25 items: eight items relevant to participants’ epidemiologic characteristics (gender, age, subspecialty,

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3 education status, professional title, employment hospital, and employment period), four items  
4 relevant to adverse exposures (medical dispute, medical lawsuits, or loss of a lawsuit ever,  
5 and colleagues' experiences of exposure), nine items surveying participants' preferences  
6 about general agreement (one item), practices in the past 12 months (four items), and harm  
7 (four items) of defensive medicine and physicians' role in defensive medicine (Table 1). The  
8 items about defensive medicine were primarily derived from previous reports and studies.  
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### 11 **Participants**

12 Participants comes across the country of China. They registered the Congress by means of  
13 on-line or post registration forms, and their certification as obstetricians and/or gynecologists  
14 were identified and confirmed by submitted materials to the Congress.  
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17 We sent out 918 printed and 886 online questionnaires to registered physicians of  
18 obstetrics and gynecology; 692 and 794 physicians responded with integrated information.  
19 Total responding rate was 82.4%. The mean age of 1486 participants was 41.1±8.2 years.  
20 There were 1337 female (90.0%) and 149 male (10.0%) physicians. As to subspecialties, 483  
21 (32.5%) participants were engaged in obstetrics, 496 (33.4%) in general gynecology, 188 (12.7%)  
22 in reproduction/gynecologic endocrinology, 223 (15.0%) in gynecologic oncology, and 96  
23 without specific subspecialty. As to education status, 976 participants (65.7%) and 510 (34.3%)  
24 had undergraduate and graduate degrees, respectively. As to professional titles, 229  
25 participants (15.4%), 536 (36.1%), and 721 (48.5%) had junior, intermediate, and senior  
26 certifications, respectively. In total, 525 participants (35.3%) had administrative duties in their  
27 hospital of employment. Regarding employment in hospitals, 80 participants (5.4%) were from  
28 private/foreign-capital healthcare services, 32 (2.2%) were from community hospitals, 536  
29 (36.1%) were from referral hospitals, 804 (54.1%) were from tertiary hospitals, and 34 (2.3%)  
30 were working in other types of healthcare services. One hundred thirty-eight (9.3%), 215  
31 (14.5%), 273 (18.4%), 218 (14.7%), and 642 (43.2%) participants had an employment period  
32 of <5 years, ≥5 years but <10 years, ≥10 years but <15 years, ≥15 years but <20 years,  
33 and ≥20 years, respectively.  
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### 40 **Measures**

41 Epidemiologic characteristics, exposure to disputes and lawsuits, and preferences were  
42 described as figures and percentages. Participants with strongly disagreed/disagreed and  
43 strongly agreed/agreed propensities were compared to determine specific factors contributing  
44 to their preferences toward defensive medicine.  
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### 47 **Statistical analysis**

48 Data were collected on Microsoft Excel tables. Statistical analyses were carried out using  
49 SPSS statistical software (version 19.0, SPSS Inc, Chicago, IL). Comparison of categorical  
50 variables between strongly disagreed/disagreed and strongly agreed/agreed participants were  
51 applied by nonparametric  $\kappa^2$  test or Fisher exact test, and difference of age was calculated  
52 using *t*-test for independent samples. Multiple-parameter analyses were performed using  
53 binary logistic analysis, calculating odds ratios (OR), and 95% confidence intervals (95% CI) to  
54 adjust confounding factors.  
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## RESULTS

### Experiences of lawsuits

Previous exposure to medical disputes, lawsuits, loss of a lawsuit, and colleagues' experiences are listed in Table 2. Of the whole cohort, 903 (60.8%), 283 (19.0%), and 170 (60.1%) participants had experienced at least one medical dispute, lawsuit, and loss of a lawsuit, but most participants had just one exposure of each type. On the other hand, 1284 (86.4%) participants had witnessed their colleagues' exposure to any medical dispute, lawsuit, or loss of a lawsuit, and more than four exposures were witnessed by almost half (41.9%) of the participants.

### Participants' preference about defensive medicine

Table 3 lists participants' preference about defensive medicine. Generally, 62.9% of participants strongly agreed or agreed with the principle of defensive medicine, and only 5.3% strongly disagreed or disagreed with it. More than half of the participants reached consensus about 7 of 12 specific items: they strongly disagreed/disagreed with *Practice 2* (53.9%), *Practice 3* (75.1%), *Practice 4* (57.8%), and *Role 2* (80.8%); and strongly agreed/agreed with *Harm 4* (70.8%), *Role 1* (51.9%), and *Role 3* (55.7%). For *Practice 1*, *Harm 1–3*, and *Role 4*, there were disparate viewpoints.

### Factors having impacts on participants' preference

In univariate analysis, most epidemiologic characteristics and personal experiences had pertinence to participants' viewpoints and preferences of defensive medicine and its specific aspects. In the multivariate regression model, independent risk factors relevant to participants' preferences included: gender; administrative duty (yes vs. no); employment hospital (tertiary vs. non-tertiary); education status (undergraduate vs. graduate); subspecialty (gynecologic oncology vs. others); any exposure to medical disputes, lawsuits, loss of a lawsuit; and colleagues' experiences (Table 4). These factors had differentiated impacts on disparate items. As independent factors, gender difference had a significant impact on seven items; having administrative duty on six items; working in tertiary hospitals on six items; education status on three items; gynecologic oncology on one item; exposure to medical disputes, lawsuits, or loss of a lawsuit on five, one, and two items, respectively; and colleagues' experiences on two items. Whether forms of the questionnaire were printed or online, age, profession title, or employment period did not influence preferences or decisions about defensive medicine in regression analysis. In general, participants were more prone to accept or endorse defensive medicine if they were female physicians; did not have administrative duties; were working in non-tertiary hospitals; had an undergraduate degree; had had exposure to any medical disputes, lawsuits or loss of a lawsuit; or had witnessed colleagues' similar exposures.

## DISCUSSION

Defensive medicine is a worldwide problem beyond the bounds of countries, economics, ideology, cultures, and religions. According to numerous reports, most physicians have practiced or been practicing defensive medicine<sup>7-11</sup>. According to a survey of physicians in Pennsylvania, defensive medicine is highly prevalent among various specialties who pay the most for liability insurance, with potentially serious implications for cost, access, and both

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3 technical and interpersonal quality of care<sup>12</sup>. “Assurance behavior” such as ordering tests,  
4 performing diagnostic procedures, and referring patients for consultation, was very common  
5 (92%)<sup>12</sup>. There is the same or even higher prevalence of defensive medicine in China. It is  
6 reported that physicians' previous experience with medical disputes is significantly associated  
7 with defensive behaviors, particularly with over-prescription<sup>13</sup>. About four-fifths of physicians  
8 “sometimes” or “often” practiced defensive medicine, according to Chinese studies. To our  
9 knowledge, this is the largest survey about defensive medicine practices in China. Not  
10 surprisingly, about two-thirds of physicians strongly agreed or agreed with defensive medicine  
11 in general; only about 5% were against it, but for specific items, more than half of the  
12 participants were against practicing defensive medicine (*Practice 2, Practice 3, Practice*  
13 *4, and Role 3*), although more than half of them were in favor of the principle of defensive  
14 medicine (*Role 1 and Harm 4*) and were alert to their patients (*Role 2*). This contradiction  
15 reflects the tension between physicians' professional idealism and stressful physician–patient  
16 relationships, which is worthy of concern from health administrators and reformers.

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21 Origins of defensive medicine may have profound juristic, economic, and cultural reasons.  
22 From a social perspective, risks should not be eliminated at all costs. This is true in general  
23 and in the medical context. When the costs of precaution are largely not borne by physicians  
24 while the costs of being found liable—in the form of reputation loss—are excessive, precaution  
25 in the form of defensive medicine is likely<sup>14</sup>. For most people, defensive medicine is a rational  
26 selection by healthcare providers based on the economic man hypothesis and expected utility  
27 theory. Risk aversion and expected utility maximization, and uncertainty about judgment of  
28 medical malpractice and vast liability risk are economic and juristic foundations of defensive  
29 medicine, whereas nonidentity of information and non-marketability of medical service are  
30 social and market-oriented causes. In America, across all claims, 55.2% resulted in litigation,  
31 ranging from 46.7% for claims against anesthesiologists to 62.6% for claims against  
32 obstetricians and gynecologists. The frequency with which claims underwent a trial verdict was  
33 as low as 4.5%, and most (79.6%) were judged in favor of the physician<sup>15</sup>. In our study, most  
34 lawsuits ended in physicians losing them (170/283, 60.1%). For most physicians, being sued  
35 has produced great pressure and severe physical and psychological torture<sup>16</sup>. Claims of  
36 malpractice or criticism of “unqualified doctors” were regarded as personal abuse. From a  
37 social perspective, loss of reputation is overwhelmingly a transfer payment, a private loss to  
38 the physician who bears it, so any investment by the physician taken to prevent such a loss is  
39 a waste from a social perspective<sup>14</sup>. In our survey, although almost all participants agreed with  
40 defensive medicine, most of them were against specific practices of it. Tension between  
41 adherence to idealism and stressful situations consists of the foundation for the practice of  
42 defensive medicine by the participants of our study.

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48 Despite widespread agreement that physicians who practice defensive medicine drive up  
49 health care costs, the extent to which defensive medicine increases costs is unclear. In the  
50 United States, the 60% increase in malpractice premiums between 2000 and 2003 is  
51 associated with an increase in total Medicare spending of more than \$15 billion<sup>17</sup>. By the most  
52 conservative estimate, overall annual medical liability system costs, including defensive  
53 medicine, are estimated to be \$55.6 billion in 2008 dollars, or 2.4% of total health care  
54 spending<sup>18</sup>. Within specialty and after adjustment for patient characteristics, higher resource  
55 use by physicians is associated with fewer malpractice claims<sup>19</sup>. Despite vast waste caused by  
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3 defensive medicine, it will not protect patients or physicians from harm. Diagnostic tests for  
4 symptoms with a low risk of serious illness do little to reassure patients, decrease their anxiety,  
5 or resolve their symptoms, although the tests may reduce further primary care visits<sup>20</sup>. Like  
6 many of our treatments, however, diagnostic testing is not without its adverse effects. The  
7 testing imperative can become addictive<sup>21</sup>. Excessive tests produce higher false positive rates  
8 and more tests, which eventually result in liability problems<sup>14</sup>. Defensive medicine also violates  
9 principles of medical ethics about rational usage of social and health resources for the best  
10 care of patients, hence causing further damage to the physician–patient relationship.

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13 How to prevent or restrict practices and the waste incurred by defensive medicine is a  
14 critical problem to both physicians and public health. It is estimated that \$38.8 billion of  
15 hospital spending could be eliminated through direct tort reforms<sup>18</sup>. Professionalism is the  
16 basis of medicine's contract with society. Physicians' efforts are to ensure that the health care  
17 systems and the physicians working within them remain committed both to patient welfare and  
18 to the basic tenets of social justice<sup>22</sup>. It was more the administrative and emotional side of  
19 medicine than trust in the profession that disappointed patients. Patients wanted to be taken  
20 seriously and provided with proper information<sup>23</sup>. Better care is always the best defense. Some  
21 authors suggested that preventive interventions should target common contributory factors  
22 across diagnoses, especially those that involve data gathering and synthesis in the  
23 patient–practitioner encounter<sup>24</sup>. Indeed, physicians in general acknowledge the need to follow  
24 practice guidelines and avoid unnecessary testing<sup>25</sup>, just as participants in our study do.

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27 Obstetrics and gynecology is always a high-risk specialty for lawsuits<sup>11</sup>. A classic example  
28 of defensive medicine is the increasing rate of cesarean sections<sup>26-29</sup>. Obstetric malpractice  
29 lawsuits and frequent worry about lawsuits are associated with a higher propensity to  
30 recommend cesarean delivery in common obstetric settings of China<sup>26</sup>. In a survey of Iran, 87%  
31 of physicians are more likely to offer the cesarean section option, even in the absence of a  
32 clear medical indication<sup>30</sup>. Although debates exist<sup>31, 32</sup>, many studies found positive  
33 correlations between the cesarean section rate and the premium<sup>33-35</sup>. Anchoring effects and  
34 priming effects of psychology may bring about bias, which could explain why obstetricians  
35 select defensive medicine as the basis for decision making. For many obstetricians, "the only  
36 regrettable cesarean section is the one not done," but as criticism and discussion about  
37 cesarean section increases in China<sup>36, 37</sup>, few physicians in our study (8.2%) agreed with  
38 cesarean section without indications.

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41 The main drawback of our study is inadequate validation of the questionnaire, which had  
42 negative impact on the credibility and repeatability. As in a questionnaire survey, there  
43 inevitable recall bias from participants. About one third participants were from tertiary hospitals  
44 or having administrative duties, which proportions were obviously higher than practical  
45 situations. These selection bias may cause deviation of conclusions even if adjusted in  
46 multivariate model. A more representative and straight attitude toward defensive medicine  
47 would be derived from appropriately sampled cohort. Confounders as economics,  
48 physician–patient relationship and culture environment were also not included in our analysis.

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51 Generally 62.9% of Chinese physicians of obstetrics and gynecology strongly agreed or  
52 agreed with defensive medicine, but there are different or even opposite preferences and  
53 understanding about specific practices, harm, and physicians' roles. In general, participants  
54 were more prone to accept or endorse defensive medicine if they were female physicians; did  
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not have administrative duties; were working in non-tertiary hospitals; had only an undergraduate degree; had exposure to any medical disputes, lawsuits, or loss of a lawsuit; and had witnessed colleagues' similar exposure.

**Contributors** LL conceived of the original idea for the study, interpreted results, carried out the statistical analysis, drafted the paper and is overall guarantor. LZ designed the questionnaire, obtained ethical approval, contributed to the preparation of the data set, interpreted results and contributed to drafts of the paper. JL contributed to the study design, interpretation of results and commented on drafts of the paper.

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**Competing interests** The authors have no conflicts of interest.

**Ethics approval** Ethical approval was sought and obtained from Peking Union Medical College Hospital, Institutional Review Board (ZS-1268).

**Data sharing statement** No additional data are available.

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# BMJ Open

## The Attitudes toward Defensive Medicine among Physicians of Obstetrics and Gynecology in China: A Questionnaire Survey in A National Congress

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3 **1 The Attitudes toward Defensive Medicine among Physicians of Obstetrics and**  
4 **2 Gynecology in China: A Questionnaire Survey in A National Congress**

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21 **16 Keywords:** defensive medicine, lawsuit, cesarean section.  
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3 18 **Objective:** The study aimed to determine prevalence, patterns, and risk factors of defensive  
4 19 medicine by obstetricians and gynecologists across China.

5 20 **Design:** This is a questionnaire survey by written and online interview for participants.

6 21 **Participants:** Among 1804 registered physicians participating at the 2017 Congress of  
7 22 Chinese Obstetricians and Gynecologists Association in Chengdu City, Sichuan Province,  
8 23 China, from August 17 to 20, 2017, 1486 participants (82.4%) responded the survey.

9 24 **Main outcome measures:** Participants' strongly disagreed/disagreed and strongly  
10 25 agreed/agreed options were compared to determine specific factors contributing to their  
11 26 preferences toward defensive medicine.

12 27 **Results:** In the whole cohort of 1486 participants, 903 (60.8%), 283 (19.0%), and 170 (60.1%)  
13 28 participants had experienced at least one medical dispute, lawsuit, or loss of a lawsuit,  
14 29 respectively; and 1284 (86.4%) participants had witnessed their colleagues exposed to  
15 30 medical disputes, lawsuits, or loss of a lawsuit. Generally, 62.9% of the participants strongly  
16 31 agreed or agreed with defensive medicine. Gender, administration duty, employment hospital,  
17 32 education status, subspecialty, exposure to any medical disputes, lawsuits, or loss of a lawsuit,  
18 33 and colleagues' experiences were independent risk factors relevant to participants'  
19 34 preferences about defensive medicine in a multivariate model. Participants were more prone  
20 35 to accept or endorse defensive medicine if they were female physicians; without administrative  
21 36 duties; working in non-tertiary hospitals; with an undergraduate degree; with any exposure to  
22 37 medical disputes, lawsuits, or loss of a lawsuit; or having witnessed colleagues' similar  
23 38 experiences.

24 39 **Conclusions:** About two-thirds of Chinese physicians practicing obstetrics and gynecology in  
25 40 our survey agreed with defensive medicine but had diverse preferences and understanding of  
26 41 specific practices, harms of defensive medicine and physician's roles.

#### 27 42 28 43 **Strengths and limitations of this study**

- 29 44 ● As to our knowledge this is the first report about defensive medicine in a large cohort of  
30 45 Chinese physicians with high correspondence rate.
- 31 46 ● We acquired practical data about Chinese physicians' preference in deciding strategies of  
32 47 diagnosis and treatment, which would provide foundations for further analysis of health  
33 48 economics of defensive medicine.
- 34 49 ● The main drawback of our study is the bias from sampling, which had negative impact on  
35 50 the credibility and repeatability.

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## 53 BACKGROUND

54 The concept of defensive medicine appeared in 1978<sup>1</sup>, and is defined as “medical actions  
55 performed mainly to prevent being sued rather than actually to aid the patient” by the United  
56 States Congress’s Office of Technology Assessment<sup>2</sup>. Defensive medicine is also one of the  
57 Mesh terms of PubMed, “the alterations of modes of medical practice, induced by the threat of  
58 liability, for the principal purposes of forestalling lawsuits by patients as well as providing good  
59 legal defense in the event that such lawsuits are instituted.”<sup>3</sup> Concerns and perceptions about  
60 medical liability lead practitioners to practice defensive medicine. In a national survey of  
61 neurosurgeons, 69% participants strongly agreed or agreed with “I view every patient as a  
62 potential lawsuit.”<sup>4</sup> As a result, diagnostic testing, consultations, and imaging studies are  
63 ordered to satisfy a perceived legal risk, resulting in higher healthcare expenditures. According  
64 to the report by the Institute of Medicine, the lower-bound totals of estimates of excess  
65 expenditures identified from workshop discussions would amount to about \$765 billion in 2009,  
66 of which the costs of defensive medicine were estimated to be \$210 billion<sup>5</sup>. In the report by  
67 Jackson Healthcare, physicians attributed 34% of overall healthcare costs to defensive  
68 medicine. Among physicians who reported practicing defensive medicine, an estimated 35% of  
69 diagnostic tests, 29% of lab tests, 19% of hospitalizations, 14% of prescriptions, and 8% of  
70 surgeries were ordered to avoid lawsuits<sup>6</sup>. However, little is known about the definite  
71 prevalence and characteristics of defensive medicine by OB/GYN physicians. In the 2017  
72 Congress of Chinese Obstetricians and Gynecologists Association (COGA), we initiated a  
73 questionnaire survey among registered physicians of OB/GYN to analyze prevalence, patterns,  
74 and risk factors of practicing and endorsing defensive medicine.

## 76 METHODS

### 77 Design

78 At the 2017 Congress of COGA in Chengdu City, Sichuan Province, China, from August 17 to  
79 20, 2017, at check-in reception of the Congress, we sent out printed and on-line  
80 questionnaires to every participant, and asked for on-site retrieve to ensure proper  
81 corresponding rate. On-line questionnaire were sent out by social media of WeChat and data  
82 were retrieved by background database. All questionnaires were check by Dr L Li and Dr L Zhu.  
83 Data were included only if all items were specified addressed. The Institutional Review Board  
84 of Peking Union Medical College Hospital (PUMCH) had approved this study.

### 86 Questionnaire

87 The items about defensive medicine were primarily derived from previous reports and studies.  
88 For validation of the questionnaire, a preliminary study was conducted among 50 physicians of  
89 Department of Obstetrics and Gynecology in PUMCH. After discussion and modification, the  
90 final version of questionnaire was approved with total and separate Cronbach  $\alpha > 0.600$ , and  
91 Kaiser-Meyer-Olkin measures  $> 0.700$ . None of the 50 physicians validating the questionnaire  
92 participated in the study.

93 There is a brief, clear, and neutral introduction about the definition, origin, and prevalence  
94 of defensive medicine at the beginning of the questionnaire, which then consists of 25 items:  
95 eight items relevant to participants’ epidemiologic characteristics (gender, age, subspecialty,  
96 education status, professional title, employment hospital, and employment period), four items



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3 97 relevant to adverse exposures (medical dispute, medical lawsuits, or loss of a lawsuit ever,  
4 98 and colleagues' experiences), nine items surveying participants' preferences about general  
5 99 agreement (one item), *Practice* in the past 12 months (four items), and *Harm* (four items) of  
6 100 defensive medicine and physicians' *Role* in defensive medicine (four items) (Table 1).  
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## 9 102 **Participants**

10 103 Participants come across China. They registered the Congress by means of on-line or post  
11 104 registration forms, and their certification as obstetricians and/or gynecologists were identified  
12 105 and confirmed by submitted materials to the Congress.  
13 106

## 14 107 **Measures**

15 108 Epidemiologic characteristics, exposure to disputes and lawsuits, and preferences were  
16 109 described as figures and percentages. Participants with strongly disagreed/disagreed and  
17 110 strongly agreed/agreed propensities were compared to determine specific factors contributing  
18 111 to their preferences toward defensive medicine.  
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## 20 113 **Statistical analysis**

21 114 Statistical analyses were carried out using SPSS statistical software (version 19.0, SPSS Inc,  
22 115 Chicago, IL). Comparison of variables were applied by nonparametric  $\kappa^2$  test or Fisher exact  
23 116 test, or *t*-test for independent samples. Multiple-parameter analyses were performed using  
24 117 binary logistic analysis, calculating odds ratios (OR), and 95% confidence intervals (95% CI) to  
25 118 adjust confounding factors. Reliability and validity of the questionnaire were evaluated with  
26 119 methods of Cronbach  $\alpha$  and Kaiser-Meyer-Olkin measures/Bartlett's test of sphericity for  
27 120 construct validity respectively.  
28 121

## 29 122 **RESULTS**

### 30 123 **Participants**

31 124 We sent out 918 printed and 886 online questionnaires to registered physicians of OB/GYN;  
32 125 692 and 794 physicians responded with integrated information. Total responding rate was  
33 126 82.4%. The average age of 1486 participants was 41.1 $\pm$ 8.2 years. There were 1337 female  
34 127 (90.0%) and 149 male (10.0%) physicians. For the cohort of 1486 responding participants, 483  
35 128 (32.5%), 496 (33.4%), 188 (12.7%), and 223 (15.0%) participants were engaged in obstetrics,  
36 129 general gynecology, reproduction/gynecologic endocrinology, and in gynecologic oncology,  
37 130 while 96 (6.4%) without specific subspecialty. As to education status, 976 participants (65.7%)  
38 131 and 510 (34.3%) had undergraduate and graduate degrees, respectively. As to professional  
39 132 titles, 229 participants (15.4%), 536 (36.1%), and 721 (48.5%) had junior, intermediate, and  
40 133 senior certifications, respectively. In total, 525 participants (35.3%) had administrative duties in  
41 134 their hospital of employment. Regarding employment status, 80 (5.4%), 32 (2.2%), 536  
42 135 (36.1%), 804 (54.1%) and 34 (2.3%) participants were from private/foreign-capital healthcare  
43 136 services, community hospitals, referral hospitals, tertiary hospitals, and other types of  
44 137 healthcare services. One hundred thirty-eight (9.3%), 215 (14.5%), 273 (18.4%), 218 (14.7%),  
45 138 and 642 (43.2%) participants had an employment period of <5 years,  $\geq$ 5 years but <10 years,  
46 139  $\geq$ 10 years but <15 years,  $\geq$ 15 years but <20 years, and  $\geq$ 20 years, respectively.  
47 140

### 141 **Reliability and validity of the questionnaire**

142 For the reliability of total and separate items of *Practice*, *Harm* and *Role*, the values of Cronbach  
143  $\alpha$  were 0.602, 0.705, 0.650 and 0.675. For the construct validity of items of *Practice*, *Harm* and  
144 *Role*, Kaiser-Meyer-Olkin measures were 0.711 ( $P < 0.001$ ), 0.755 ( $P < 0.001$ ) and 0.740 ( $P <$   
145  $0.001$ ). Printed and online questionnaire had similar reliability and validity (all  $P$  values  $> 0.05$ ).

### 147 **Experiences of lawsuits**

148 Previous exposure to medical disputes, lawsuits, loss of a lawsuit, and colleagues'  
149 experiences are listed in Table 2. Of the whole responding cohort of 1486 participants, 903  
150 (60.8%), 283 (19.0%), and 170 (60.1%) participants had experienced at least one medical  
151 dispute, lawsuit, and loss of a lawsuit, but most participants had just once exposure of each  
152 type. On the other hand, 1284 (86.4%) participants had witnessed their colleagues'  
153 experiences, and more than four times exposures were witnessed by almost half (41.9%) of  
154 the participants.

### 156 **Participants' preference about defensive medicine**

157 Table 3 lists participants' preference about defensive medicine. Generally, 62.9% of  
158 participants strongly agreed or agreed with the principle of defensive medicine, and only 5.3%  
159 strongly disagreed or disagreed with it. More than half of the participants reached consensus  
160 about 7 of 12 specific items: they strongly disagreed/disagreed with *Practice 2* (53.9%),  
161 *Practice 3* (75.1%), *Practice 4* (57.8%), and *Role 2* (80.8%); and strongly agreed/agreed with  
162 *Harm 4* (70.8%), *Role 1* (51.9%), and *Role 3* (55.7%). For *Practice 1*, *Harm 1–3*, and *Role 4*,  
163 there were no predominant viewpoints in more than half participants.

### 165 **Factors having impacts on participants' preference**

166 In univariate analysis, most epidemiologic characteristics and personal experiences had  
167 pertinence to participants' viewpoints and preferences of defensive medicine and its specific  
168 aspects. As shown in Table 4, in the multivariate regression model, independent risk factors  
169 relevant to participants' preferences included: gender; administrative duty (yes vs. no);  
170 employment hospital (tertiary vs. non-tertiary); education status (undergraduate vs. graduate);  
171 subspecialty (gynecologic oncology vs. others); any exposure to medical disputes, lawsuits,  
172 loss of a lawsuit; and colleagues' experiences. In general, participants were more prone to  
173 accept or endorse defensive medicine if they were female physicians; did not have  
174 administrative duties; were working in non-tertiary hospitals; had an undergraduate degree;  
175 had had exposure to any medical disputes, lawsuits or loss of a lawsuit; or had witnessed  
176 colleagues' similar experiences. Whether forms of the questionnaire were printed or online,  
177 participants' age, profession title, or employment period did not influence preferences or  
178 decisions about defensive medicine in multivariate analysis.

### 180 **DISCUSSION**

181 Defensive medicine is a worldwide problem beyond the bounds of countries, economics,  
182 ideology, cultures, and religions. According to numerous reports, most physicians have  
183 practiced or been practicing defensive medicine<sup>7-11</sup>. According to a survey of physicians in  
184 Pennsylvania, defensive medicine is highly prevalent among various specialties who pay the

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3 185 most for liability insurance<sup>12</sup>. In China, it is reported that physicians' previous experience with  
4 186 medical disputes is significantly associated with defensive behaviors, particularly with  
5 187 over-prescription<sup>13</sup>. To our knowledge, this is the largest survey about defensive medicine  
6 188 practices in China. Not surprisingly, about two-thirds of physicians strongly agreed or agreed  
7 189 with defensive medicine in general; only about 5% were against it, but for specific items, more  
8 190 than half of the participants were against practicing defensive medicine (*Practice 2, Practice 3,*  
9 191 *Practice 4, and Role 3*), although more than half of them were in favor of the principle of  
10 192 defensive medicine (*Role 1 and Harm 4*) and were alert to their patients (*Role 2*). This  
11 193 contradiction probably resulted from the tension between physicians' professional idealism  
12 194 and stressful physician–patient relationships, which is worthy of concern from health  
13 195 administrators and reformers.

14 196 Origins of defensive medicine have profound juristic, economic, and cultural reasons. From  
15 197 a social perspective, risks should not be eliminated at all costs. When the costs of precaution  
16 198 are largely not borne by physicians while the costs of being found liable—in the form of  
17 199 reputation loss—are excessive, precaution in the form of defensive medicine is likely<sup>14</sup>. For  
18 200 most people, defensive medicine is a rational selection by healthcare providers based on the  
19 201 economic man hypothesis and expected utility theory. Risk aversion and expected utility  
20 202 maximization, uncertainty about judgment of medical malpractice, and vast liability risk are  
21 203 economic and juristic foundations of defensive medicine, whereas nonidentity of information  
22 204 and non-marketability of medical service are social and market-oriented causes. In the United  
23 205 States, across all claims, 62.6% resulted in litigation against obstetricians and gynecologists,  
24 206 and most (79.6%) were judged in favor of the physician<sup>15</sup>. Nevertheless, in our study most  
25 207 lawsuits ended in physicians losing them (170/283, 60.1%). For most physicians, being sued  
26 208 has produced great pressure and severe physical and psychological torture<sup>16</sup>. Claims of  
27 209 malpractice or criticism of “unqualified doctors” were regarded as personal abuse, loss of  
28 210 reputation is overwhelmingly a transfer payment, a private loss to the physician who bears it,  
29 211 so any investment by the physician taken to prevent such a loss is a waste from a social  
30 212 perspective<sup>14</sup>.

31 213 Despite widespread agreement that physicians who practice defensive medicine drive up  
32 214 health care costs, the extent to which defensive medicine increases costs is unclear. In the  
33 215 United States, the 60% increase in malpractice premiums between 2000 and 2003 is  
34 216 associated with an increase in total Medicare spending of more than \$15 billion<sup>17</sup>. By the most  
35 217 conservative estimate, overall annual medical liability system costs, including defensive  
36 218 medicine, are estimated to be \$55.6 billion in 2008 dollars, or 2.4% of total health care  
37 219 spending<sup>18</sup>. Within specialty and after adjustment for patient characteristics, higher resource  
38 220 use by physicians is associated with fewer malpractice claims<sup>19</sup>. Despite vast waste caused by  
39 221 defensive medicine, it will not protect patients or physicians from harm. Diagnostic tests for  
40 222 symptoms with a low risk of serious illness do little to reassure patients, decrease their anxiety,  
41 223 or resolve their symptoms, although the tests may reduce further primary care visits<sup>20</sup>.  
42 224 However, diagnostic testing is not without its adverse effects. The testing imperative can  
43 225 become addictive<sup>21</sup>. Excessive tests produce higher false positive rates and more tests, which  
44 226 eventually result in liability problems<sup>14</sup>. Defensive medicine also violates principles of medical  
45 227 ethics about rational usage of social and health resources for the best care of patients, causing  
46 228 further damage to the physician–patient relationship.

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3 229 How to prevent or restrict practices and the waste incurred by defensive medicine is a  
4 230 critical problem to both physicians and public health. Better care is always the best defense.  
5 231 Professionalism is the basis of medicine's contract with society. Physicians' efforts are to  
6 232 ensure that the health care systems and the physicians working within them remain committed  
7 233 both to patient welfare and to the basic tenets of social justice<sup>22</sup>. Patients wanted to be taken  
8 234 seriously and provided with proper information<sup>23</sup>. Preventive interventions should target  
9 235 common contributory factors across diagnoses, especially those that involve data gathering  
10 236 and synthesis in the patient-practitioner encounter<sup>24</sup>. Indeed, physicians in general  
11 237 acknowledge the need to follow practice guidelines and avoid unnecessary testing<sup>25</sup>, just as  
12 238 participants in our study do.

13 239 Obstetrics and gynecology is always a high-risk specialty for lawsuits<sup>11</sup>. A classic example  
14 240 of defensive medicine is the increasing rate of cesarean sections<sup>26-29</sup>. Obstetric malpractice  
15 241 lawsuits and frequent worry about lawsuits are associated with a higher propensity to  
16 242 recommend cesarean delivery in common obstetric settings of China<sup>26</sup>. In a survey of Iran, 87%  
17 243 of physicians are more likely to offer the cesarean section option, even in the absence of a  
18 244 clear medical indication<sup>30</sup>. Although debates exist<sup>31, 32</sup>, many studies found positive  
19 245 correlations between the cesarean section rate and the premium<sup>33-35</sup>. Anchoring effects and  
20 246 priming effects of psychology may bring about bias, which could explain why obstetricians  
21 247 select defensive medicine as the basis for decision making. For many obstetricians, "the only  
22 248 regrettable cesarean section is the one not done," but as criticism and discussion about  
23 249 cesarean section increases in China<sup>36, 37</sup>, few physicians in our study (8.2%) agreed with  
24 250 cesarean section without indications.

25 251 The main drawback of our study is the bias from sampling, which had negative impact on  
26 252 the credibility and repeatability. A more representative and straight attitude toward defensive  
27 253 medicine would be derived from appropriately sampled cohort. Confounders as economics,  
28 254 physician-patient relationship and culture environment were also not included in our analysis.

29 255 In conclusion, 62.9% of Chinese physicians of OB/GYN strongly agreed or agreed with  
30 256 defensive medicine, but there are diverse or even opposite preferences and understanding  
31 257 about specific practices, harm, and physicians' roles.

32 258  
33 259 **Contributors** LL conceived of the original idea for the study, interpreted results, carried out the  
34 260 statistical analysis, drafted the paper and is overall guarantor. LZ designed the questionnaire,  
35 261 obtained ethical approval, contributed to the preparation of the data set, interpreted results and  
36 262 contributed to drafts of the paper. JL contributed to the study design, interpretation of results  
37 263 and commented on drafts of the paper.

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40 266  
41 267 **Competing interests** The authors have no conflicts of interest.

42 268  
43 269 **Ethics approval** Ethical approval was sought and obtained from Peking Union Medical  
44 270 College Hospital, Institutional Review Board (ZS-1268).

45 271  
46 272 **Data sharing statement** No additional data are available.

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3 2734 274 **Acknowledgement**

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6 276

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- 35 349

350 **Table 1. Items of questionnaire about defensive medicine****General agreement about defensive medicine****Practices of defensive medicine in past 12 months**

- Practice 1* Refusing to provide treatment for critically ill patients
- Practice 2* Prescription for unnecessary examinations/tests/recipes/consultations
- Practice 3* Arrangements for unnecessary hospital administration/surgeries
- Practice 4* Cesarean section without indications (not equal to “cesarean delivery on maternal request”)

**Harm of defensive medicine**

- Harm 1* Defensive medicine would impair physician–patient relationship and induce new conflicts
- Harm 2* Defensive medicine would impair patients' physical and psychological health
- Harm 3* Defensive medicine would restrict physicians' mentality, creativity, and medical progression
- Harm 4* Defensive medicine would protect physicians/patients from harm despite its defects

**Physicians' roles in defensive medicine**

- Role 1* Physicians shouldn't seek protection by defensive medicine for rights, interests, and security
- Role 2* Physicians shouldn't treat patient as potential threat of a medical lawsuit
- Role 3* Physicians should stick to guidelines and basic principles in daily practice
- Role 4* Physicians should be solely devoted to patients' best interests even if that is expensive

351 Participants respond to each item with preferences of “strongly  
 352 disagreed,” “disagreed,” “neutral,” “agreed,” or “strongly agreed”.

353

354 **Table 2. Medical disputes, lawsuits, loss of a lawsuit experienced by physician or**  
 355 **colleagues**

	<b>Medical disputes (n = 1486)</b>	<b>Medical lawsuits (n = 1486)</b>	<b>Losing a lawsuit (n = 283)</b>	<b>Medical disputes, lawsuits, loss of a lawsuit experienced by colleagues (n = 1486)</b>
None	583 (39.2%)	1203 (81.0%)	113 (39.9%)	202 (13.6%)
Once	458 (30.8%)	193 (13.0%)	121 (42.8%)	266 (17.9%)
Twice	180 (12.1%)	41 (2.8%)	27 (9.5%)	280 (18.8%)
Three times	112 (7.5%)	25 (1.7%)	10 (3.5%)	116 (7.8%)
≥ four times	153 (10.3%)	24 (1.6%)	12 (4.2%)	622 (41.9%)

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**Table 3. Participants' preference about defensive medicine and its practice and harm and their roles**

	<b>Strongly disagreed</b>	<b>Disagreed</b>	<b>Neutral</b>	<b>Agreed</b>	<b>Strongly agreed</b>
<b>General agreement about defensive medicine</b>	15 (1.0%)	64 (4.3%)	472 (31.8%)	865 (58.2%)	70 (4.7%)
<b>Practices of defensive medicine</b>					
<i>Practice 1</i>	129 (8.7%)	415 (27.9%)	579 (39.0%)	284 (19.1%)	79 (5.3%)
<i>Practice 2</i>	189 (12.7%)	612 (41.2%)	481 (32.4%)	181 (12.2%)	23 (1.5%)
<i>Practice 3</i>	315 (21.2%)	801 (53.9%)	255 (17.2%)	100 (6.7%)	15 (1.0%)
<i>Practice 4</i>	253 (17.0%)	607 (40.8%)	504 (33.9%)	110 (7.4%)	12 (0.8%)
<b>Harms of defensive medicine</b>					
<i>Harm 1</i>	77 (5.2%)	404 (27.2%)	571 (38.4%)	387 (26.0%)	47 (3.2%)
<i>Harm 2</i>	97 (6.5%)	508 (34.2%)	502 (33.8%)	344 (23.1%)	35 (2.4%)
<i>Harm 3</i>	85 (5.7%)	468 (31.5%)	431 (29.0%)	442 (29.7%)	60 (4.0%)
<i>Harm 4</i>	10 (0.7%)	36 (2.4%)	388 (26.1%)	988 (66.5%)	64 (4.3%)
<b>Physicians' roles in defensive medicine</b>					
<i>Role 1</i>	38 (2.6%)	117 (7.9%)	560 (37.7%)	646 (43.5%)	125 (8.4%)
<i>Role 2</i>	336 (22.6%)	865 (58.2%)	205 (13.8%)	71 (4.8%)	9 (0.6%)
<i>Role 3</i>	35 (2.4%)	184 (12.4%)	440 (29.6%)	744 (50.1%)	83 (5.6%)
<i>Role 4</i>	61 (4.1%)	265 (17.8%)	478 (32.2%)	579 (39.0%)	103 (6.9%)

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**Table 4. Independent factors of defensive medicine and its practice, harm, and physicians' roles in logistic regression models**

OR (95% CI)	Female	Administration duty	Tertiary hospital	Graduate degree	Subspecialty of gynecologic oncology	Any exposure of medical dispute	Any exposure of medical lawsuit	Any exposure of losing a lawsuit	Colleagues' experiences
<b>General agreement</b>	7.6 (4.6-12.7) P<0.001	0.6 (0.4-1.0) P=0.035	0.5 (0.3-0.9) P=0.015	-	-	-	-	-	-
<b>Practices of defensive medicine</b>									
<i>Practice 1</i>	-	0.4 (0.3-0.6) P<0.001	0.6 (0.4-0.8) P<0.001	0.6 (0.4-0.9) P=0.011	-	1.9 (1.4-2.5) P<0.001	-	-	-
<i>Practice 2</i>	-	-	-	-	-	1.8 (1.3-2.4) P=0.001	-	-	-
<i>Practice 3</i>	-	-	-	0.4 (0.3-0.7) P=0.001	-	-	-	-	-
<i>Practice 4</i>	0.3 (0.2-0.5) P<0.001	1.7 (1.2-2.5) P=0.008	-	-	-	-	-	-	3.0 (1.3-7.0) P=0.012
<b>Harms of defensive medicine</b>									
Harm 1	-	1.4 (1.0-1.8) P=0.021	1.4 (1.1-1.9) P=0.007	-	-	-	-	-	-
Harm 2	0.5 (0.3-0.7) P=0.001	1.4 (1.1-1.9) P=0.009	-	1.4 (1.0-1.8) P=0.035	-	1.4 (1.1-1.9) P=0.008	-	-	-
Harm 3	0.6 (0.4-1.0) P=0.031	1.6 (1.2-2.1) P<0.001	1.4 (1.1-1.9) P=0.003	-	-	-	-	-	-
Harm 4	0.6 (0.4-0.9) P=0.022	-	-	-	-	-	1.5 (1.1-2.1) P=0.010	-	-

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Physician's	roles	in							
<b>defensive medicine</b>									
Role 1	0.4 (0.2-0.6)	-	1.7 (1.2-2.5)	-	-	0.6 (0.4-0.9)	-	-	-
	P<0.001		P=0.004			P=0.007			
Role 2	0.4 (0.2-0.6)	-	-	-	4.0 (2.4-6.6)	0.4 (0.3-0.7)	-	-	x
	P=0.001				P<0.001	P=0.001			
Role 3	-	-	-	-	-	-	-	0.2 (0.1-0.6)	-
								P=0.001	
Role 4	-	-	-	-	-	-	-	0.4 (0.2-0.8)	-
								P=0.015	

- denotes non-significance. OR, odds ratio. 95% CI, 95% confidence interval.

For peer review only

## STROBE Statement—checklist of items that should be included in reports of observational studies

	<b>Item No</b>	<b>Recommendation</b>
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract <b>Page 1, line 1-2</b>
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found <b>Page 2, line 18-41</b>
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported <b>Page 3, line 54-71</b>
Objectives	3	State specific objectives, including any prespecified hypotheses <b>Page 3, line 71-74</b>
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper <b>Page 3, line 77-100</b>
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection <b>Page 3, line 77-81</b>
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants <b>Page 4, line 102-105</b>
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group <b>Page 4, line 107-111</b>
Bias	9	Describe any efforts to address potential sources of bias <b>Page 2-3, line 93-100</b>
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed

(d) *Cohort study*—If applicable, explain how loss to follow-up was addressed  
*Case-control study*—If applicable, explain how matching of cases and controls was addressed  
*Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy

**Page 4, line 113-120**

(e) Describe any sensitivity analyses

## Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed <b>Page 4, line 123-139</b> (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders <b>Page 4, line 123-139</b> (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <b>Page 5, line 147-163</b> <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included <b>Page 5, line 165-178</b> (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

## Discussion

Key results	18	Summarise key results with reference to study objectives <b>Page 5-6, line 181-195</b>
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias <b>Page 7, line 251-254</b>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <b>Page 6, line 196-228</b>
Generalisability	21	Discuss the generalisability (external validity) of the study results <b>Page 7, line 229-250</b>

## Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
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3 \*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and  
4 unexposed groups in cohort and cross-sectional studies.  
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6 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and  
7 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely  
8 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at  
9 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is  
10 available at [www.strobe-statement.org](http://www.strobe-statement.org).  
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# BMJ Open

## The Attitudes toward Defensive Medicine among Physicians of Obstetrics and Gynecology in China: A Questionnaire Survey in A National Congress

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<b>Primary Subject Heading</b>:	Health policy
Secondary Subject Heading:	Medical education and training
Keywords:	defensive medicine, lawsuit, cesarean section

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1 **The Attitudes toward Defensive Medicine among Physicians of Obstetrics and**  
2 **Gynecology in China: A Questionnaire Survey in A National Congress**

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15  
16 **Keywords:** defensive medicine, lawsuit, cesarean section.  
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3 18 **Objective:** The study aimed to determine prevalence, patterns, and risk factors of defensive  
4 19 medicine by obstetricians and gynecologists across China.

5 20 **Design:** This is a questionnaire survey by written and online interview for participants.

6 21 **Participants:** Among 1804 registered physicians participating at the 2017 Congress of  
7 22 Chinese Obstetricians and Gynecologists Association in Chengdu City, Sichuan Province,  
8 23 China, from August 17 to 20, 2017, 1486 participants (82.4%) responded the survey.

9 24 **Main outcome measures:** Participants' strongly disagreed/disagreed and strongly  
10 25 agreed/agreed options were compared to determine specific factors contributing to their  
11 26 preferences toward defensive medicine.

12 27 **Results:** In the whole cohort of 1486 participants, 903/1486 (60.8%), 283/1486 (19.0%), and  
13 28 170/283 (60.1%) participants had experienced at least one medical dispute, lawsuit, or loss of  
14 29 a lawsuit, respectively; and 1284 (86.4%) participants had witnessed their colleagues exposed  
15 30 to medical disputes, lawsuits, or loss of a lawsuit. Generally, 62.9% of the participants strongly  
16 31 agreed or agreed with defensive medicine. Gender, administration duty, employment hospital,  
17 32 education status, subspecialty, exposure to any medical disputes, lawsuits, or loss of a lawsuit,  
18 33 and colleagues' experiences were independent risk factors relevant to participants'  
19 34 preferences about defensive medicine in a multivariate model. Participants were more prone  
20 35 to accept or endorse defensive medicine if they were female physicians; without administrative  
21 36 duties; working in non-tertiary hospitals; with an undergraduate degree; with any exposure to  
22 37 medical disputes, lawsuits, or loss of a lawsuit; or having witnessed colleagues' similar  
23 38 experiences.

24 39 **Conclusions:** About two-thirds of Chinese physicians practicing obstetrics and gynecology in  
25 40 our survey agreed with the practice of defensive medicine, but they had diverse preferences  
26 41 and understanding of specific practices, harms of defensive medicine and physician's roles.

#### 27 42 28 43 **Strengths and limitations of this study**

- 29 44 ● As to our knowledge this is the first report about defensive medicine in a large cohort of  
30 45 Chinese physicians with high correspondence rate.
- 31 46 ● We acquired practical data about Chinese physicians' preference in deciding strategies of  
32 47 diagnosis and treatment, which would provide foundations for further analysis of health  
33 48 economics of defensive medicine.
- 34 49 ● The main drawback of our study is the bias from sampling, which had negative impact on  
35 50 the credibility and repeatability.

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## 53 BACKGROUND

54 The concept of defensive medicine appeared in 1978<sup>1</sup>, and is defined as “medical actions  
55 performed mainly to prevent being sued rather than actually to aid the patient” by the United  
56 States Congress’s Office of Technology Assessment<sup>2</sup>. Defensive medicine is also one of the  
57 Mesh terms of PubMed, “the alterations of modes of medical practice, induced by the threat of  
58 liability, for the principal purposes of forestalling lawsuits by patients as well as providing good  
59 legal defense in the event that such lawsuits are instituted.”<sup>3</sup> Concerns and perceptions about  
60 medical liability lead practitioners to practice defensive medicine. In a national survey of  
61 neurosurgeons, 69% participants strongly agreed or agreed with “I view every patient as a  
62 potential lawsuit.”<sup>4</sup> As a result, diagnostic testing, consultations, and imaging studies are  
63 ordered to satisfy a perceived legal risk, resulting in higher healthcare expenditures. According  
64 to the report by the Institute of Medicine, the lower-bound totals of estimates of excess  
65 expenditures identified from workshop discussions would amount to about \$765 billion in 2009,  
66 of which the costs of defensive medicine were estimated to be \$210 billion<sup>5</sup>. In the report by  
67 Jackson Healthcare, physicians attributed 34% of overall healthcare costs to defensive  
68 medicine. Among physicians who reported practicing defensive medicine, an estimated 35% of  
69 diagnostic tests, 29% of lab tests, 19% of hospitalizations, 14% of prescriptions, and 8% of  
70 surgeries were ordered to avoid lawsuits<sup>6</sup>. However, little is known about the definite  
71 prevalence and characteristics of defensive medicine by OB/GYN physicians. In the 2017  
72 Congress of Chinese Obstetricians and Gynecologists Association (COGA), we initiated a  
73 questionnaire survey among registered physicians of OB/GYN to analyze prevalence, patterns,  
74 and risk factors of practicing and endorsing defensive medicine.

## 76 METHODS

### 77 Design

78 At the 2017 Congress of COGA in Chengdu City, Sichuan Province, China, from August 17 to  
79 20, 2017, at check-in reception of the Congress, we sent out printed and on-line  
80 questionnaires to every participant, and asked for on-site retrieve to ensure proper  
81 corresponding rate. On-line questionnaire were sent out by social media of WeChat and data  
82 were retrieved by background database. All questionnaires were check by Dr L Li and Dr L Zhu.  
83 Data were included only if all items were specified addressed. The Institutional Review Board  
84 of Peking Union Medical College Hospital (PUMCH) had approved this study.

### 86 Questionnaire

87 The items about defensive medicine were primarily derived from previous reports and studies.  
88 For validation of the questionnaire, a preliminary study was conducted among 50 physicians of  
89 Department of Obstetrics and Gynecology in PUMCH. After discussion and modification, the  
90 final version of questionnaire was approved with total and separate Cronbach  $\alpha >0.600$ , and  
91 Kaiser-Meyer-Olkin measures  $>0.700$ . None of the 50 physicians validating the questionnaire  
92 participated in the study.

93 There is a brief, clear, and neutral introduction about the definition, origin, and prevalence  
94 of defensive medicine at the beginning of the questionnaire, which then consists of 25 items:  
95 eight items relevant to participants’ epidemiologic characteristics (gender, age, subspecialty,  
96 education status, professional title, employment hospital, and employment period), four items

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3 97 relevant to adverse exposures (medical dispute, medical lawsuits, or loss of a lawsuit ever,  
4 98 and colleagues' experiences), thirteen items surveying participants' preferences about general  
5 99 agreement (one item), *Practice* in the past 12 months (four items), and *Harm* (four items) of  
6 100 defensive medicine and physicians' *Role* in defensive medicine (four items) (Table 1).  
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## 9 102 **Participants**

10 103 Participants came across China. They registered the Congress by means of on-line or post  
11 104 registration forms, and their certification as obstetricians and/or gynecologists were identified  
12 105 and confirmed by submitted materials to the Congress.  
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## 15 107 **Measures**

16 108 Epidemiologic characteristics, exposure to disputes and lawsuits, and preferences were  
17 109 described as figures and percentages. Participants with strongly disagreed/disagreed and  
18 110 strongly agreed/agreed propensities were compared to determine specific factors contributing  
19 111 to their preferences toward defensive medicine.  
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## 22 113 **Statistical analysis**

23 114 Statistical analyses were carried out using SPSS statistical software (version 19.0, SPSS Inc,  
24 115 Chicago, IL). Comparison of variables were applied by nonparametric  $\kappa^2$  test or Fisher exact  
25 116 test, or *t*-test for independent samples. The impact of epidemiologic characteristics and  
26 117 personal experiences on the participants' viewpoints and preferences of defensive medicine  
27 118 and its specific aspects were analyzed in univariate analysis. Multiple-parameter analyses  
28 119 were performed using binary logistic analysis, calculating odds ratios (OR), and 95%  
29 120 confidence intervals (95% CI) to adjust confounding factors. Reliability and validity of the  
30 121 questionnaire were evaluated with methods of Cronbach  $\alpha$  and Kaiser-Meyer-Olkin  
31 122 measures/Bartlett's test of sphericity for construct validity respectively.  
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## 36 124 **RESULTS**

### 37 125 **Participants**

38 126 We sent out 918 printed and 886 online questionnaires to registered physicians of OB/GYN;  
39 127 692 and 794 physicians responded with integrated information. Total responding rate was  
40 128 82.4%. The average age of 1486 participants was 41.1 $\pm$ 8.2 years. There were 1337 female  
41 129 (90.0%) and 149 male (10.0%) physicians. For the cohort of 1486 responding participants, 483  
42 130 (32.5%), 496 (33.4%), 188 (12.7%), and 223 (15.0%) participants were engaged in obstetrics,  
43 131 general gynecology, reproduction/gynecologic endocrinology, and in gynecologic oncology,  
44 132 while 96 (6.4%) without specific subspecialty. As to education status, 976 participants (65.7%)  
45 133 and 510 (34.3%) had undergraduate and graduate degrees, respectively. As to professional  
46 134 titles, 229 participants (15.4%), 536 (36.1%), and 721 (48.5%) had junior, intermediate, and  
47 135 senior certifications, respectively. In total, 525 participants (35.3%) had administrative duties in  
48 136 their hospital of employment. Regarding employment status, 80 (5.4%), 32 (2.2%), 536  
49 137 (36.1%), 804 (54.1%) and 34 (2.3%) participants were from private/foreign-capital healthcare  
50 138 services, community hospitals, referral hospitals, tertiary hospitals, and other types of  
51 139 healthcare services. One hundred thirty-eight (9.3%), 215 (14.5%), 273 (18.4%), 218 (14.7%),  
52 140 and 642 (43.2%) participants had an employment period of <5 years,  $\geq$ 5 years but <10 years,  
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3 141 ≥10 years but <15 years, ≥15 years but <20 years, and ≥20 years, respectively.

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### 5 143 **Reliability and validity of the questionnaire**

6 144 For the reliability of total and separate items of *Practice*, *Harm* and *Role*, the values of Cronbach  
7 145  $\alpha$  were 0.602, 0.705, 0.650 and 0.675. For the construct validity of items of *Practice*, *Harm* and  
8 146 *Role*, Kaiser-Meyer-Olkin measures were 0.711 ( $P < 0.001$ ), 0.755 ( $P < 0.001$ ) and 0.740 ( $P <$   
9 147 0.001). Printed and online questionnaire had similar reliability and validity (all  $P$  values  $>0.05$ ).  
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### 11 149 **Experiences of lawsuits**

12 150 Previous exposure to medical disputes, lawsuits, loss of a lawsuit, and colleagues'  
13 151 experiences are listed in Table 2. Of the whole responding cohort of 1486 participants, 903  
14 152 (60.8%), 283 (19.0%), and 170 (60.1%) participants had experienced at least one medical  
15 153 dispute, lawsuit, and loss of a lawsuit, but most participants had just once exposure of each  
16 154 type. On the other hand, 1284 (86.4%) participants had witnessed their colleagues'  
17 155 experiences, and more than four times exposures were witnessed by almost half (41.9%) of  
18 156 the participants.  
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### 20 158 **Participants' preference about defensive medicine**

21 159 Table 3 lists participants' preference about defensive medicine. Generally, 62.9% of  
22 160 participants strongly agreed or agreed with the practice of defensive medicine, and only 5.3%  
23 161 strongly disagreed or disagreed with it. More than half of the participants reached consensus  
24 162 about 7 of 12 specific items: they strongly disagreed/disagreed with *Practice 2* (53.9%),  
25 163 *Practice 3* (75.1%), *Practice 4* (57.8%), and *Role 2* (80.8%); and strongly agreed/agreed with  
26 164 *Harm 4* (70.8%), *Role 1* (51.9%), and *Role 3* (55.7%). For *Practice 1*, *Harm 1–3*, and *Role 4*,  
27 165 there were no predominant viewpoints in more than half participants.  
28 166

### 29 167 **Factors having impacts on participants' preference**

30 168 In univariate analysis, most epidemiologic characteristics and personal experiences had  
31 169 pertinence to participants' viewpoints and preferences of defensive medicine and its specific  
32 170 aspects. As shown in Table 4, in the multivariate regression model, independent risk factors  
33 171 relevant to participants' preferences included: gender; administrative duty (yes vs. no);  
34 172 employment hospital (tertiary vs. non-tertiary); education status (undergraduate vs. graduate);  
35 173 subspecialty (gynecologic oncology vs. others); any exposure to medical disputes, lawsuits,  
36 174 loss of a lawsuit; and colleagues' experiences. In general, participants were more prone to  
37 175 accept or endorse defensive medicine if they were female physicians; did not have  
38 176 administrative duties; were working in non-tertiary hospitals; had an undergraduate degree;  
39 177 had had exposure to any medical disputes, lawsuits or loss of a lawsuit; or had witnessed  
40 178 colleagues' similar experiences. Whether forms of the questionnaire were printed or online,  
41 179 participants' age, profession title, or employment period did not influence preferences or  
42 180 decisions about defensive medicine in multivariate analysis.  
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## 44 182 **DISCUSSION**

45 183 Defensive medicine is a worldwide problem beyond the bounds of countries, economics,  
46 184 ideology, cultures, and religions. Although some authors defined defensive medicine as  
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3 185 “positive” (beneficial for patients) and “negative” (detrimental for patients), but defensive  
4 186 medicine was generally regarded as a negative behavior. According to numerous reports,  
5 187 most physicians have practiced or been practicing defensive medicine<sup>7-11</sup>. According to a  
6 188 survey of physicians in Pennsylvania, defensive medicine is highly prevalent among various  
7 189 specialties who pay the most for liability insurance<sup>12</sup>. In China, it is reported that physicians’  
8 190 previous experience with medical disputes is significantly associated with defensive behaviors,  
9 191 particularly with over-prescription<sup>13</sup>. To our knowledge, this is the largest survey about  
10 192 defensive medicine practices in China. Not surprisingly, about two-thirds of physicians strongly  
11 193 agreed or agreed with defensive medicine in general; only about 5% were against it, but for  
12 194 specific items, more than half of the participants were against practicing defensive medicine  
13 195 (*Practice 2, Practice 3, Practice 4, and Role 3*), although more than half of them were in favor  
14 196 of the principle of defensive medicine (*Role 1 and Harm 4*) and were alert to their patients  
15 197 (*Role 2*). This contradiction probably resulted from the tension between physicians’  
16 198 professional idealism and stressful physician–patient relationships, which is worthy of concern  
17 199 from health administrators and reformers.

20 200 Origins of defensive medicine have profound juristic, economic, and cultural reasons. From  
21 201 a social perspective, risks should not be eliminated at all costs. When the costs of precaution  
22 202 are largely not borne by physicians while the costs of being found liable—in the form of  
23 203 reputation loss—are excessive, precaution in the form of defensive medicine is likely<sup>14</sup>. For  
24 204 most people, defensive medicine is a rational selection by healthcare providers based on the  
25 205 economic man hypothesis and expected utility theory. Risk aversion and expected utility  
26 206 maximization, uncertainty about judgment of medical malpractice, and vast liability risk are  
27 207 economic and juristic foundations of defensive medicine, whereas nonidentity of information  
28 208 and non-marketability of medical service are social and market-oriented causes. In the United  
29 209 States, across all claims, 62.6% resulted in litigation against obstetricians and gynecologists,  
30 210 and most (79.6%) were judged in favor of the physician<sup>15</sup>. Nevertheless, in our study most  
31 211 lawsuits ended in physicians losing them (170/283, 60.1%). For most physicians, being sued  
32 212 has produced great pressure and severe physical and psychological torture<sup>16</sup>. Claims of  
33 213 malpractice or criticism of “unqualified doctors” were regarded as personal abuse, loss of  
34 214 reputation is overwhelmingly a transfer payment, a private loss to the physician who bears it,  
35 215 so any investment by the physician taken to prevent such a loss is a waste from a social  
36 216 perspective<sup>14</sup>.

37 217 Despite widespread agreement that physicians who practice defensive medicine drive up  
38 218 health care costs, the extent to which defensive medicine increases costs is unclear. In the  
39 219 United States, the 60% increase in malpractice premiums between 2000 and 2003 is  
40 220 associated with an increase in total Medicare spending of more than \$15 billion<sup>17</sup>. By the most  
41 221 conservative estimate, overall annual medical liability system costs, including defensive  
42 222 medicine, are estimated to be \$55.6 billion in 2008 dollars, or 2.4% of total health care  
43 223 spending<sup>18</sup>. Within specialty and after adjustment for patient characteristics, higher resource  
44 224 use by physicians is associated with fewer malpractice claims<sup>19</sup>. Despite vast waste caused by  
45 225 defensive medicine, it will not protect patients or physicians from harm. Diagnostic tests for  
46 226 symptoms with a low risk of serious illness do little to reassure patients, decrease their anxiety,  
47 227 or resolve their symptoms, although the tests may reduce further primary care visits<sup>20</sup>.  
48 228 However, diagnostic testing is not without its adverse effects. The testing imperative can

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3 229 become addictive<sup>21</sup>. Excessive tests produce higher false positive rates and more tests, which  
4 230 eventually result in liability problems<sup>14</sup>. Defensive medicine also violates principles of medical  
5 231 ethics about rational usage of social and health resources for the best care of patients, causing  
6 232 further damage to the physician–patient relationship.

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8 233 How to prevent or restrict practices and the waste incurred by defensive medicine is a  
9 234 critical problem to both physicians and public health. Better care is always the best defense.  
10 235 Professionalism is the basis of medicine's contract with society. Physicians' efforts are to  
11 236 ensure that the health care systems and the physicians working within them remain committed  
12 237 both to patient welfare and to the basic tenets of social justice<sup>22</sup>. Patients wanted to be taken  
13 238 seriously and provided with proper information<sup>23</sup>. Preventive interventions should target  
14 239 common contributory factors across diagnoses, especially those that involve data gathering  
15 240 and synthesis in the patient–practitioner encounter<sup>24</sup>. Indeed, physicians in general  
16 241 acknowledge the need to follow practice guidelines and avoid unnecessary testing<sup>25</sup>, just as  
17 242 participants in our study do.

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20 243 Obstetrics and gynecology is always a high-risk specialty for lawsuits<sup>11</sup>. A classic example  
21 244 of defensive medicine is the increasing rate of cesarean sections<sup>26-29</sup>. Obstetric malpractice  
22 245 lawsuits and frequent worry about lawsuits are associated with a higher propensity to  
23 246 recommend cesarean delivery in common obstetric settings of China<sup>26</sup>. In a survey of Iran, 87%  
24 247 of physicians are more likely to offer the cesarean section option, even in the absence of a  
25 248 clear medical indication<sup>30</sup>. Although debates exist<sup>31, 32</sup>, many studies found positive  
26 249 correlations between the cesarean section rate and the premium<sup>33-35</sup>. Anchoring effects and  
27 250 priming effects of psychology may bring about bias, which could explain why obstetricians  
28 251 select defensive medicine as the basis for decision making. For many obstetricians, “the only  
29 252 regrettable cesarean section is the one not done,” but as criticism and discussion about  
30 253 cesarean section increases in China<sup>36, 37</sup>, few physicians in our study (8.2%) agreed with  
31 254 cesarean section without indications.

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35 255 The main drawback of our study is the bias from sampling, which had negative impact on  
36 256 the credibility and repeatability. A more representative and straight attitude toward defensive  
37 257 medicine would be derived from appropriately sampled cohort. Confounders as economics,  
38 258 physician-patient relationship and culture environment were also not included in our analysis.

39 259 In conclusion, 62.9% of Chinese physicians of OB/GYN strongly agreed or agreed with the  
40 260 practice of defensive medicine, but there are diverse or even opposite preferences and  
41 261 understanding about specific practices, harm, and physicians' roles.

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44 263 **Contributors** LL conceived of the original idea for the study, interpreted results, carried out the  
45 264 statistical analysis, drafted the paper and is overall guarantor. LZ designed the questionnaire,  
46 265 obtained ethical approval, contributed to the preparation of the data set, interpreted results and  
47 266 contributed to drafts of the paper. JL contributed to the study design, interpretation of results  
48 267 and commented on drafts of the paper.

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52 270  
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54 271 **Competing interests** The authors have no conflicts of interest.

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3 **Ethics approval** Ethical approval was sought and obtained from Peking Union Medical  
4 College Hospital, Institutional Review Board (ZS-1268).

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7 **Data sharing statement** No additional data are available.

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354 **Table 1. Items of questionnaire about defensive medicine****General agreement about defensive medicine****Practices of defensive medicine in past 12 months**

<i>Practice 1</i>	Refusing to provide treatment for critically ill patients
<i>Practice 2</i>	Prescription for unnecessary examinations/tests/recipes/consultations
<i>Practice 3</i>	Arrangements for unnecessary hospital administration/surgeries
<i>Practice 4</i>	Cesarean section without indications (not equal to “cesarean delivery on maternal request”)

**Harm of defensive medicine**

<i>Harm 1</i>	Defensive medicine would impair physician–patient relationship and induce new conflicts
<i>Harm 2</i>	Defensive medicine would impair patients' physical and psychological health
<i>Harm 3</i>	Defensive medicine would restrict physicians' mentality, creativity, and medical progression
<i>Harm 4</i>	Defensive medicine would protect physicians/patients from harm despite its defects

**Physicians' roles in defensive medicine**

<i>Role 1</i>	Physicians shouldn't seek protection by defensive medicine for rights, interests, and security
<i>Role 2</i>	Physicians shouldn't treat patient as potential threat of a medical lawsuit
<i>Role 3</i>	Physicians should stick to guidelines and basic principles in daily practice
<i>Role 4</i>	Physicians should be solely devoted to patients' best interests even if that is expensive

355 Participants respond to each item with preferences of “strongly  
 356 disagreed,” “disagreed,” “neutral,” “agreed,” or “strongly agreed”.

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358 **Table 2. Medical disputes, lawsuits, loss of a lawsuit experienced by physician or**  
 359 **colleagues**

	<b>Medical disputes (n = 1486)</b>	<b>Medical lawsuits (n = 1486)</b>	<b>Losing a lawsuit (n = 283)</b>	<b>Medical disputes, lawsuits, loss of a lawsuit experienced by colleagues (n = 1486)</b>
None	583 (39.2%)	1203 (81.0%)	113 (39.9%)	202 (13.6%)
Once	458 (30.8%)	193 (13.0%)	121 (42.8%)	266 (17.9%)
Twice	180 (12.1%)	41 (2.8%)	27 (9.5%)	280 (18.8%)
Three times	112 (7.5%)	25 (1.7%)	10 (3.5%)	116 (7.8%)
≥ four times	153 (10.3%)	24 (1.6%)	12 (4.2%)	622 (41.9%)

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**Table 3. Participants' preference about defensive medicine and its practice and harm and their roles**

	<b>Strongly disagreed</b>	<b>Disagreed</b>	<b>Neutral</b>	<b>Agreed</b>	<b>Strongly agreed</b>
<b>General agreement about defensive medicine</b>	15 (1.0%)	64 (4.3%)	472 (31.8%)	865 (58.2%)	70 (4.7%)
<b>Practices of defensive medicine</b>					
<i>Practice 1</i>	129 (8.7%)	415 (27.9%)	579 (39.0%)	284 (19.1%)	79 (5.3%)
<i>Practice 2</i>	189 (12.7%)	612 (41.2%)	481 (32.4%)	181 (12.2%)	23 (1.5%)
<i>Practice 3</i>	315 (21.2%)	801 (53.9%)	255 (17.2%)	100 (6.7%)	15 (1.0%)
<i>Practice 4</i>	253 (17.0%)	607 (40.8%)	504 (33.9%)	110 (7.4%)	12 (0.8%)
<b>Harms of defensive medicine</b>					
<i>Harm 1</i>	77 (5.2%)	404 (27.2%)	571 (38.4%)	387 (26.0%)	47 (3.2%)
<i>Harm 2</i>	97 (6.5%)	508 (34.2%)	502 (33.8%)	344 (23.1%)	35 (2.4%)
<i>Harm 3</i>	85 (5.7%)	468 (31.5%)	431 (29.0%)	442 (29.7%)	60 (4.0%)
<i>Harm 4</i>	10 (0.7%)	36 (2.4%)	388 (26.1%)	988 (66.5%)	64 (4.3%)
<b>Physicians' roles in defensive medicine</b>					
<i>Role 1</i>	38 (2.6%)	117 (7.9%)	560 (37.7%)	646 (43.5%)	125 (8.4%)
<i>Role 2</i>	336 (22.6%)	865 (58.2%)	205 (13.8%)	71 (4.8%)	9 (0.6%)
<i>Role 3</i>	35 (2.4%)	184 (12.4%)	440 (29.6%)	744 (50.1%)	83 (5.6%)
<i>Role 4</i>	61 (4.1%)	265 (17.8%)	478 (32.2%)	579 (39.0%)	103 (6.9%)

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**Table 4. Independent factors of defensive medicine and its practice, harm, and physicians' roles in logistic regression models**

OR (95% CI)	Female	Administration duty	Tertiary hospital	Graduate degree	Subspecialty of gynecologic oncology	Any exposure of medical dispute	Any exposure of medical lawsuit	Any exposure of losing a lawsuit	Colleagues' experiences
<b>General agreement</b>	7.6 (4.6-12.7) P<0.001	0.6 (0.4-1.0) P=0.035	0.5 (0.3-0.9) P=0.015	-	-	-	-	-	-
<b>Practices of defensive medicine</b>									
<i>Practice 1</i>	-	0.4 (0.3-0.6) P<0.001	0.6 (0.4-0.8) P<0.001	0.6 (0.4-0.9) P=0.011	-	1.9 (1.4-2.5) P<0.001	-	-	-
<i>Practice 2</i>	-	-	-	-	-	1.8 (1.3-2.4) P=0.001	-	-	-
<i>Practice 3</i>	-	-	-	0.4 (0.3-0.7) P=0.001	-	-	-	-	-
<i>Practice 4</i>	0.3 (0.2-0.5) P<0.001	1.7 (1.2-2.5) P=0.008	-	-	-	-	-	-	3.0 (1.3-7.0) P=0.012
<b>Harms of defensive medicine</b>									
Harm 1	-	1.4 (1.0-1.8) P=0.021	1.4 (1.1-1.9) P=0.007	-	-	-	-	-	-
Harm 2	0.5 (0.3-0.7) P=0.001	1.4 (1.1-1.9) P=0.009	-	1.4 (1.0-1.8) P=0.035	-	1.4 (1.1-1.9) P=0.008	-	-	-
Harm 3	0.6 (0.4-1.0) P=0.031	1.6 (1.2-2.1) P<0.001	1.4 (1.1-1.9) P=0.003	-	-	-	-	-	-
Harm 4	0.6 (0.4-0.9) P=0.022	-	-	-	-	-	1.5 (1.1-2.1) P=0.010	-	-

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Physician's	roles	in							
<b>defensive medicine</b>									
Role 1	0.4 (0.2-0.6)	-	1.7 (1.2-2.5)	-	-	0.6 (0.4-0.9)	-	-	-
	P<0.001		P=0.004			P=0.007			
Role 2	0.4 (0.2-0.6)	-	-	-	4.0 (2.4-6.6)	0.4 (0.3-0.7)	-	-	x
	P=0.001				P<0.001	P=0.001			
Role 3	-	-	-	-	-	-	-	0.2 (0.1-0.6)	-
								P=0.001	
Role 4	-	-	-	-	-	-	-	0.4 (0.2-0.8)	-
								P=0.015	

- denotes non-significance. OR, odds ratio. 95% CI, 95% confidence interval.

For peer review only

## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract <b>Page 1, line 1-2</b>
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found <b>Page 2, line 18-41</b>
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported <b>Page 3, line 54-71</b>
Objectives	3	State specific objectives, including any prespecified hypotheses <b>Page 3, line 71-74</b>
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper <b>Page 3, line 77-100</b>
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection <b>Page 3, line 77-81</b>
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants <b>Page 4, line 102-105</b>
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group <b>Page 4, line 107-111</b>
Bias	9	Describe any efforts to address potential sources of bias <b>Page 2-3, line 93-100</b>
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed

(d) *Cohort study*—If applicable, explain how loss to follow-up was addressed  
*Case-control study*—If applicable, explain how matching of cases and controls was addressed  
*Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy

**Page 4, line 113-120**

(e) Describe any sensitivity analyses

## Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed <b>Page 4, line 123-139</b> (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders <b>Page 4, line 123-139</b> (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <b>Page 5, line 147-163</b> <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included <b>Page 5, line 165-178</b> (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

## Discussion

Key results	18	Summarise key results with reference to study objectives <b>Page 5-6, line 181-195</b>
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias <b>Page 7, line 251-254</b>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <b>Page 6, line 196-228</b>
Generalisability	21	Discuss the generalisability (external validity) of the study results <b>Page 7, line 229-250</b>

## Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
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3 \*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and  
4 unexposed groups in cohort and cross-sectional studies.  
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6 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and  
7 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely  
8 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at  
9 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is  
10 available at [www.strobe-statement.org](http://www.strobe-statement.org).  
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