Understanding the Deterrence in Medical Insurance Fund Regulatory Systems for Fraud and Abuse Behaviors by Enrollees in China: An Analysis Based on Deterrence Theory

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Abstract

Background: To effectively improve the regulatory systems of medical insurance, a deep dive into their impact on enrollees is essential. The challenge lies in comprehensively and quantitatively assessing these effects, amidst a noticeable research gap in evaluating regulatory impacts within the medical insurance domain. This study aimed to develop a conceptual framework based on deterrence theory to assess the effects of medical insurance regulations on deterring medical insurance fraud and abuse (MIFA) among enrollees, focusing on Shanghai as a case study.

Methods: This study integrated data for analysis from three distinct sources and used mixed methods. The Database of Medical Insurance Supervision on Enrollees (DMISE), spanning 2017 to 2021, provided a foundational analysis of the system's implementation. We utilized a multistage stratified sampling method to conduct a questionnaire survey to gauge enrollees' perceptions of deterrence, employing the Enrollees' Perceived Deterrence Scale (EPDS), developed for this study. Semi-structured interviews with key informants offered deeper insights into the regulatory systems. Our evaluation was guided by a conceptual framework that identified three key dimensions of deterrence: severity, certainty, and celerity.

Results: Our study analyzed 12,898 historical fraud and abuse cases, involving 10,723 enrollees, alongside 965 valid questionnaires. It revealed that the medical insurance regulatory system in Shanghai exerted a high level of deterrence. Enrollees rated the perceived severity of the regulatory system as the highest. Although administrative sanctions were the primary measures, and were effective, there is a need for greater intensity and precision in their application. The certainty of detection was high, at approximately 80–90%. Whilst some covert activities remained difficult to detect, the certainty of enforcement was approximately 99%. Celerity received the lowest scores, indicating delays in both detection and penalty imposition within the regulatory response.

Conclusion: The study developed a theoretical analytical framework to assess the effectiveness of deterrence within medical insurance regulatory systems. It identified both the strengths and weaknesses of severity, certainty, and celerity in the current regulatory system, providing valuable insights for enhancing deterrence. These findings offer important guidance for policymakers to strengthen regulatory schemes against MIFA, contributing to the advancement of more effective healthcare policies.

Background

Medical insurance fraud and abuse (MIFA), defined as practices that, whether directly or indirectly, lead to unwarranted costs for the medical insurance fund, are critical issues that pose significant threats to the financial stability of medical insurance funds[1,2]. Individual enrollees as key actors in these fraudulent activities, often an overlooked group, play a pivotal role in affecting the security of the medical insurance fund. Since 2013, the coverage of basic medical insurance in China has consistently covered over 95% of the population, encompassing approximately 1.36 billion individuals[3]. This extensive coverage, however, brings forth challenges in monitoring and controlling fraud and abuse.
Statistics from 2011 to 2021 indicate that a significant 66.67% of the publicly disclosed cases of medical insurance fraud in China were perpetrated by enrollees; these include illegal activities, such as reselling medical insurance-reimbursed prescription drugs for illicit use, fabricating information, concealing facts, or using various illicit methods to obtain benefits or funds\[^2\]-\[^4\]. These acts are frequently concealed, employing a variety of methods and sometimes involving repeat offenders, thereby exacerbating the complexity of addressing this issue\[^5\].

Combating medical insurance fraud and abuse perpetrated by enrollees is a critical challenge confronting health systems worldwide. Establishing an effective regulatory scheme is critical for government intervention in insurance markets to prevent and combat fraud and abuse within medical insurance systems\[^6\]-\[^7\]. Medical insurance regulation is defined as the law enforcement activities conducted by medical insurance regulatory authorities. These activities involve the supervision and inspection of medical practices and associated costs within the coverage of medical insurance, in strict adherence to relevant laws, regulations, rules, policies, and agreements\[^8\]. In most countries, particularly in developing nations, medical insurance regulatory systems are in a continuous state of development, and have not yet achieved full maturity\[^9\]. The effectiveness of regulatory systems remains a subject for ongoing enhancement. To enhance the effectiveness of regulatory schemes, it is imperative to gain a comprehensive understanding of the current impact of these regulatory systems on enrollees. This understanding is crucial to identify key areas for improvement. A thorough analysis of existing regulatory approaches and their effectiveness can provide vital insights, enabling policymakers and administrators to target critical issues and implement necessary reforms to strengthen the overall integrity and efficiency of the medical insurance system.

In China, the establishment and improvement of a comprehensive medical insurance regulatory system is a task of significant importance for the government. In recent years, China has emphasized establishing and enhancing its medical insurance legal framework, exemplified by the 2020 enactment of the *Regulations on the Supervision and Administration of the Use of Medical Security Funds* by the State Council, and the creation of specialized enforcement departments. Unlike some Western countries, the varying levels of China's medical insurance pooling have resulted in differences in medical insurance regulatory policies and their implementation across diverse regions\[^10\]. Shanghai, a provincial-level city, as one of the earliest and most developed regions in medical insurance regulation, exemplifies the progress and intricacies of China's medical insurance regulatory system\[^11\]. Analyzing Shanghai as a representative region can offer valuable insights into the effectiveness of regulatory strategies and their adaptability to local contexts.

Deterrence theory offers a promising framework for comprehending the effectiveness of regulatory schemes in medical insurance. It encompasses the elements of severity, certainty, and celerity\[^12\], suggesting that these three dimensions play a crucial role in deterring medical insurance fraud and abuse\[^13\]-\[^14\]. Applying deterrence theory to analyze medical insurance regulatory systems enables the gathering of comprehensive information, thereby facilitating a deeper understanding of these systems.
Using deterrence theory, this study aimed to construct a structural framework for a comprehensive analysis of deterrence effectiveness in medical insurance regulation. Based on this framework, a detailed analysis was conducted, encompassing both the objective aspects of regulatory implementation and the subjective perceptions of enrollees. By evaluating Shanghai’s regulatory systems, the study aimed to deepen the understanding of the governmental regulatory landscape in healthcare. Such insights are extremely valuable for policymakers and regulatory authorities, as they offer a nuanced understanding of the practical challenges and current state within the regulatory systems, thereby contributing to the broader discourse on healthcare policy and the improvement of regulation systems.

**Research framework**

**Conceptual and theoretical framework**

The concept of deterrence is increasingly seen as a hallmark of effective medical insurance regulation in both policy-making and scholarly analysis. Deterrence known as “deterrent effectiveness,” represents an external influence that induces a sense of caution or apprehension in regulated entities, thereby affecting their behavioral decisions[^15]. This term is widely utilized across various disciplines to describe the function of legal norms and law enforcement mechanisms. Our research draws on Becker’s deterrence theory to delve deeper into and analyze the concept of deterrence, applying it specifically to the context of medical insurance regulation. Originating from the discipline of criminology, deterrence theory conceptualizes criminal behavior as a rational decision-making process, in which individuals weigh the potential benefits and losses in seeking to maximize their own interests[^16,17]. According to its classic formulation, an individual is less likely to commit a crime if the expected gains from the crime are less than or equal to the costs of committing it. This can be expressed as[^18,19]:

\[
g \leq D \\
D = p \times (f + \lambda t) \times c
\]

Where, \(g\) represents the individual’s expected net gain after accounting for the inherent cost of the illegal behavior; \(D\) signifies the cost borne by the offender due to institutional punishment (also known as deterrence); \(p\) denotes the probability of detecting the illegal or punishable act (also known as the certainty of sanction); \((f + \lambda t)\) signifies the intensity of punishment (also known as the severity of sanction); \(f\) stands for the monetary fine; \(t\) indicates the duration of the punishment; \(\lambda\) reflects the negative utility of being punished; and \(c\) represents the speed at which punishment is administered after an illegal act is detected (also known as the celerity of sanction). It could be argued that the deterrence effectuated by legal jurisdiction on criminals is directly derived from the objective characteristics of the punishment at the macro level, namely its severity, certainty, and celerity.
The deterrence of a sanction rests on the premise that potential offenders are aware, or believe they understand, the consequences of their actions. The perception of the deterrence exerted by regulatory systems among those who are regulated is a crucial measure of the actual strength of deterrence\textsuperscript{[20]}. Scholars, such as Waldo (1972), have suggested that the perceived deterrence by individuals is intricately linked to the objective characteristics of the punishment. Perceptual deterrence theory frames deterrence as a social psychological process at the individual level. This process encompasses not only the perceptions of the certainty, severity, and celerity of sanctions, but also includes considerations of informal sanctioning factors\textsuperscript{[21,22,23]}. Such factors include societal disapproval (subjective norms), self-repudiation (sense of shame), and moral restraint\textsuperscript{[24,25]}. These elements collectively contribute to the individual's assessment of the risks associated with both formal and informal sanctions.

**Analytical framework**

This study is centrally focused on two pivotal concepts: the deterrence exerted by medical insurance regulatory systems, and the perceived deterrence among enrollees. These notions encapsulate a dual-perspective exploration of the deterrent effect in medical insurance regulation, examining both the perspective of the regulatory framework itself, and that of the regulated entities. This study constructs an analytical framework grounded in deterrence theory, aiming to clarify and assess the current state of deterrence within the medical insurance regulatory system.

As shown in Figure 1, the theoretical analysis framework initially elucidates the intrinsic mechanisms underlying both the deterrence of the regulatory system and the enrollees' perception of this deterrence. Within the framework, the principal dimensions that constitute both the deterrence of the regulatory system and the perceived deterrence among enrollees, along with their interrelationships, are presented. Additionally, the framework delineates the relationship between the medical insurance regulatory system's deterrence and the enrollees' perceived deterrence. It posits that the system's deterrence directly influences the intensity of the enrollees' perceived deterrence, which in turn reflects the extent of the system's deterrence. The perceptions of enrollees regarding severity, certainty, celerity, and subjective norms, are direct reflections of the regulatory system's corresponding attributes, as well as the social constraint environment within the medical insurance sector.

**Methods**

**Study setting**

This study was conducted in Shanghai, China, and focused on the enrollees in Shanghai's basic medical insurance, including both Urban Employee Basic Medical Insurance (UEBMI) and Urban and Rural Residents' Basic Medical Insurance (URRBMI). As a major developed coastal city in eastern China, Shanghai is home to a registered population of 15 million. By 2022, the basic medical insurance
coverage in Shanghai had reached over 96%. The Shanghai Medical Insurance Supervision and Inspection Institute (SMISII), a specialized regulatory body for the basic medical insurance system, operates under the authorization of the Shanghai Healthcare Security Administration. Its primary role is to enforce administrative laws in the supervision and inspection of the medical insurance system. A key responsibility of SMISII is the supervision of fraud and abuse among the enrollees, ensuring the safety and effectiveness of the insurance system.

**Data sources**

*Database of Medical Insurance Supervision of Enrollees*

The dataset used in analyzing the status of objective regulatory deterrence was from the Database of Medical Insurance Supervision of Enrollees (DMISE), and included data recorded by the SMISII pertaining to the review and processing of fraud and abuse cases. The database included enrollees who were identified for suspected fraud and abuse activities, spanning from January 2017 to December 2021. At the individual level, the DMISE collects comprehensive information on age, gender, and medical insurance. It also includes detailed information on the supervision review of enrollees (e.g., the time taken to review enrollee supervision, decisions on actions) and the status of imposed penalties (e.g., fines, suspension of benefits). It serves as a fundamental micro-level database reflecting the medical insurance regulatory authority’s supervision of enrollees and related issues in Shanghai, China.

*Semi-structured interviews*

This study conducted semi-structured interviews with key informants to provide rich and detailed insights into the medical insurance regulatory systems. Informants included senior management and business managers of SMISII, as well as staff members from the medical insurance departments of designated hospitals. Through semi-structured interviews, we gathered information about the design, implementation, and actual operation of the medical insurance regulation system for enrollees in Shanghai. Based on the principle of “information saturation,” this study conducted interviews with 9 key informants knowledgeable about medical insurance regulatory policies. The principle dictated that the interviews were concluded as soon as the information gathered was deemed sufficient to fulfill the objectives of the research analysis. All interviews were conducted in Mandarin Chinese. Data from these interviews were transcribed verbatim in Chinese. Following standard qualitative research procedures, two researchers independently reviewed all transcripts twice and coded the dataset. The coding dimensions were aligned with deterrence theory, facilitating the extraction of pertinent information.

*Questionnaire survey*

To collect data on enrollees’ perceived deterrence regarding medical insurance regulatory systems, we used a multistage stratified sampling method. Initially, three municipal districts (Xuhui, Jiading, and Putuo) with varied socioeconomic statuses were selected. From each, three communities of different
population sizes were chosen, and 60–80 respondents were randomly recruited from each. Eligible participants were those enrolled in Shanghai Basic Medical Insurance, aged 18 or above, and able to complete the survey independently.

Based on the guideline suggesting a sample size of 5-to-10 times the number of scale items, the minimum sample was determined to be 130\textsuperscript{[27]}. However, to accommodate the 30% dropout rate observed in the pilot study, and enhance statistical robustness, we aimed for a final sample size of approximately 1,000.

The survey was conducted using an online format from September to October 2022, taking into consideration the need for reduced interpersonal contact during the COVID-19 pandemic. We collaborated with primary care institutions and neighborhood committees in the sampled regions. In each community, 2 or 3 trained investigators were responsible for contacting participants through community WeChat channels, and for assisting them in completing the survey via a provided URL. These investigators also offered continuous support to respondents throughout the survey process, ensuring a smooth completion of the questionnaire and offering support in resolving any technical issues. Prior to participation, participants provided electronic written consent. The completion of the questionnaire took about 5–10 minutes on average, and each participant was reimbursed for their time (about $5 per person).

**Measurements**

*Indicators of deterrence*

We used six indicators to measure objective deterrence in this study: variety and intensity of regulatory measures, certainty and celerity of detection, and certainty and celerity of enforcement. These indicators are aligned with the dimensions of severity, certainty, and celerity as proposed in deterrence theory, shown in Figure 2. These indicators have been widely used in related research to measure various facets of deterrence\textsuperscript{[24,30,31]}. "Variety of regulatory measures" quantified the types of disciplinary actions employed by medical insurance authorities against MIFA, based on the active measures used. "Intensity of regulatory measures" was defined by the number and strength of actions implemented. "Certainty of detection" measured the likelihood of identifying violators through methods like online monitoring, with a ratio of investigated to total fraud cases. "Certainty of enforcement" was the probability that violators would be penalized, calculated as the ratio of penalized individuals to those found in violation. "Celerity of detection" and "celerity of enforcement" assessed the speed of identifying violators and of executing disciplinary actions, respectively, measured as the time from behavior occurrence to notification, and from notification to action implementation. The computation of these indicators utilized data from the DMISE. Methodologies for each indicator are detailed in Appendix Table 1.

*Questionnaires*
This study used a self-developed questionnaire to collect relevant information from the enrollees. It comprised four sections: screening, demographics, health status, and the Enrollees’ Perceived Deterrence Scale (EPDS). The screening section adhered to specific inclusion and exclusion criteria. The demographic section collected personal information such as gender, age, educational level, type of insurance, marital status, and occupation. The health status section focused on patient illnesses and their utilization of healthcare services. The EPDS, a 13-item scale with four dimensions rated on a five-point Likert scale (total score range 13–65), measured enrollees' perceived deterrence regarding the medical insurance regulatory system\textsuperscript{[30]}. The EPDS has demonstrated high reliability and validity through comprehensive assessments. The Cronbach’s $\alpha$ in this study was 0.924. To ensure data quality and accuracy, two additional quality control items were included in the EPDS, as shown in Appendix Table 2. Responses were deemed invalid and were excluded from the main analysis if participants consistently chose the same answer across all 15 items and completed the survey in less than the average time of 440 seconds.

**Statistical analysis**

We conducted a descriptive statistical analysis of DMISE’s regulatory activities from 2017 to 2021, and the perceived deterrence among enrollees in Shanghai. For the EPDS, given the differing number of questions within its four dimensions, we calculated dimension scores as averages, dividing each dimension's total score by its number of questions. This calculation method produced scores for both individual dimensions and the overall scale, with values ranging from 1 to 5.

In our statistical analysis, P values were generated using appropriate statistical tests based on the nature of the data for each analysis conducted. For normally distributed continuous data, we used t-tests to compare means, while for categorical data, chi-square tests were utilized as appropriate. The level of significance was set at $P < 0.05$ for all statistical tests.

All statistical procedures were executed using Microsoft Excel and Stata 17.0.

**Results**

**Basic information on data and sample demographics**

*Basic information on DMISE*

From 2017 to 2021, the DMISE recorded a total of 10,723 enrollees involved in 12,898 cases. The SMISII identified 7 types of fraud and abuse activities, which included repeated visits or excessive dispensing (96.8%), lending of medical insurance cards (2.6%), impersonation using medical insurance cards (3.4%), selling of drugs covered by medical insurance (0.4%), compensated transfers (0.1%), and forgery or alteration of medical insurance vouchers (<0.01%).
Respondent characteristics

A total of 1,770 individuals who met the eligibility criteria were invited to participate in the survey. Among them, 1,655 participants (93.50%) completed the questionnaire, and the final sample consisted of 965 individuals (58.31%) who passed the response quality assessment. The majority were female (59.69%) and Shanghai natives with local household registration (87.36%). Just over 60% of the participants had obtained a college degree or higher. The distribution of insurance coverage among the respondents revealed that the majority were beneficiaries of the UEBMI. Their marital status was predominantly married (70.78%), with just over 60% of the respondents being employed. Approximately 25% of the respondents reported monthly earnings of between 10,000 and 50,000 yuan. Health status reports indicated that the majority (62.73%) of the respondents were free from any diseases, while a smaller proportion reported experiencing multiple diseases. Additionally, a few respondents reported receiving review notices from regulatory authorities within the past five years. Detailed characteristics are provided in Table 1.
Table 1. Demographic characteristics of the survey population (N=965)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>389</td>
<td>40.31</td>
</tr>
<tr>
<td>Female</td>
<td>576</td>
<td>59.69</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–29 years</td>
<td>218</td>
<td>22.59</td>
</tr>
<tr>
<td>30–44 years</td>
<td>272</td>
<td>28.19</td>
</tr>
<tr>
<td>45–59 years</td>
<td>238</td>
<td>24.66</td>
</tr>
<tr>
<td>60+ years</td>
<td>237</td>
<td>24.56</td>
</tr>
<tr>
<td><strong>Household registration location</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shanghai</td>
<td>843</td>
<td>87.36</td>
</tr>
<tr>
<td>Other</td>
<td>122</td>
<td>12.64</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>32</td>
<td>3.32</td>
</tr>
<tr>
<td>Secondary school</td>
<td>137</td>
<td>14.2</td>
</tr>
<tr>
<td>High school</td>
<td>200</td>
<td>20.73</td>
</tr>
<tr>
<td>College degree or above (including associate degree)</td>
<td>596</td>
<td>61.76</td>
</tr>
<tr>
<td><strong>Medical insurance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UEBMI</td>
<td>763</td>
<td>79.07</td>
</tr>
<tr>
<td>URBMI</td>
<td>185</td>
<td>19.17</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td>1.76</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>683</td>
<td>70.78</td>
</tr>
<tr>
<td>Unmarried</td>
<td>214</td>
<td>22.18</td>
</tr>
<tr>
<td>Other (Such as: divorced, separated, widowed, etc.)</td>
<td>68</td>
<td>7.05</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>592</td>
<td>61.35</td>
</tr>
<tr>
<td>Retired</td>
<td>259</td>
<td>26.84</td>
</tr>
</tbody>
</table>
Unemployed 114 11.81

**Gross income per month (RMB, ¥)**\(^a\)

\begin{tabular}{|c|c|c|}
\hline
≥50,000 & 159 & 23.31 \\
>10,000 and ≤50,000 & 170 & 24.93 \\
>6,500 and ≤10,000 & 166 & 24.34 \\
>3,000 and ≤6,500 & 139 & 20.38 \\
<3,000 & 48 & 7.04 \\
\hline
\end{tabular}

**Health state**

\begin{tabular}{|c|c|c|}
\hline
Disease-free & 579 & 62.73 \\
Suffering from a disease & 205 & 22.21 \\
Suffering from a variety of diseases & 139 & 15.06 \\
\hline
\end{tabular}

**Had received review notice from the regulatory**\(^b\)

\begin{tabular}{|c|c|c|}
\hline
Yes & 29 & 4.14 \\
No & 671 & 95.86 \\
\hline
\end{tabular}

Abbreviations: UEBMI: urban employee basic medical insurance; URBMI: urban and rural residents basic medical insurance.

Notes.

\(^a\) Not all respondents answered; there were 283 missing samples.

\(^b\) Not all respondents answered; there were 265 missing samples.

**The deterrence of the basic medical insurance regulatory system**

**Severity of the regulatory system**

Based on the DMISE data, we analyzed the variety and intensity of regulatory measures. Table 2 presents the types of regulatory measures to reflect the variety. The penalties applied to MIFA could be categorized into four types: economic penalties, benefits restrictions, judicial means, and other measures. The majority of cases (88.78%) implemented refunds as the penalty measure. A small proportion of cases (5.24%) involved suspending the settlement. Less than 2% of cases resulted in exemption from penalty, and other measures had been infrequently used in the past five years of regulation.
Table 2. Types of punitive measures in medical insurance regulation

<table>
<thead>
<tr>
<th>Types</th>
<th>Measures</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic penalties</td>
<td>Ordering the returning of funds</td>
<td>11,447</td>
<td>88.75%</td>
</tr>
<tr>
<td></td>
<td>Fines a</td>
<td>4</td>
<td>0.03%</td>
</tr>
<tr>
<td>Benefits restrictions</td>
<td>Suspending the settlement b</td>
<td>676</td>
<td>5.24%</td>
</tr>
<tr>
<td>Judicial means</td>
<td>Transfer to judicial departments</td>
<td>1</td>
<td>0.01%</td>
</tr>
<tr>
<td>Other measures</td>
<td>Immunity from penalties</td>
<td>213</td>
<td>1.65%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>671</td>
<td>5.20%</td>
</tr>
</tbody>
</table>

Notes:
a Refers to a monetary penalty imposed for fraudulent claims, calculated as two-to-ten times the defrauded amount as stipulated by regulations.
b Refers to the temporary suspension of networked medical cost settlements for individuals who violate regulations, with the suspension period ranging from three to twelve months.

Regarding the intensity of regulatory enforcement, Table 3 shows that repeat offenders received significantly higher mean estimates than first-time offenders in terms of the number of punitive measures and the amount of refunds. However, no significant difference was observed in other measures, such as the amount of fines or the duration of settlement suspension. Nearly all cases (99.12%) were addressed with a single measure, while a small proportion (0.88%) involved two measures.

Table 3. Comparative analysis of penalties between first-time and repeat offenders

<table>
<thead>
<tr>
<th>Measures</th>
<th>First-time offenders</th>
<th>Repeat offenders</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Number of Punitive measures</td>
<td>10,723</td>
<td>1.008</td>
<td>0.001</td>
</tr>
<tr>
<td>Amount of refunds a</td>
<td>9,493</td>
<td>1634.5</td>
<td>26.04</td>
</tr>
<tr>
<td>Amount of fines a</td>
<td>2</td>
<td>750</td>
<td>250</td>
</tr>
<tr>
<td>Suspending the settlement b</td>
<td>583</td>
<td>147.92</td>
<td>7.275</td>
</tr>
</tbody>
</table>

Abbreviations: SD standard deviation.

Notes:
a The unit is in Chinese Yuan (CNY).
b The unit is in days.
According to the survey results from the enrollees, as shown in Appendix Table 3 and Figure 4, the perceived severity of medical insurance regulation was the highest among all dimensions of the scale. On average, the perceived severity of regulations was rated as 4.445 (±0.691) out of 5, with the vast majority of participants scoring a severity above 4. Moreover, itemized analysis within Appendix Table 4 reveals that enrollees perceived psychological pressure as the most intense, with an average score of 4.486 out of 5. In contrast, the perceived severity of economic penalties scored was rated the lowest at 4.413 out of 5, closely followed by the impact on social reputation, which scored 4.417 out of 5.

Certainty of the regulatory system

In evaluating the certainty of detection of the basic medical insurance regulatory system, our analysis focused on the procedures of regulatory review, the annual change in the number of cases, and the experience of regulatory managers, based primarily on Shanghai’s medical insurance regulation practices.

The review process in Shanghai involves three main steps, shown in Figure 3. Initially, regulatory authorities conduct broad monitoring of all enrollees through three channels: system audits for two specific anomalies, real-time monitoring with intelligent medical insurance systems, and investigation of reports. If anomalous behavior is detected, further manual examination of the enrollee’s medical records assesses potential violations. Subsequently, if both automated and manual reviews suggest a violation, the individual is summoned for a "face-to-face" audit at a medical insurance office to confirm the specific infraction. This comprehensive monitoring, enhanced by intelligent systems, allows for accurate identification of violations. The manual review builds on this to ensure precision. Except in special cases, the majority of those notified complied with the face-to-face audit, despite some violators managing to evade detection. Through these rigorous steps, approximately 80–90% of violators could be identified.

Additionally, Figure 4 illustrates the fluctuation in the number of cases handled. In 2017, a total of 1,958 cases were addressed, with about 3,000 cases each in 2018 and 2019. Due to the COVID-19 pandemic, which restricted manual checks and face-to-face audits in 2020, only 799 cases were processed. However, as the pandemic situation in China eased, this number increased to 4,000 cases in 2021. This trend underlines how the certainty of detecting violations is greatly affected by the review system’s functionality, highlighting that regulatory certainty remains stable when the review system operates normally.

In terms of the certainty of enforcement, statistical analysis shows that from 2017 to 2021, all 12,898 cases received certain handling opinions, with only 1.65% of cases being exempt from sanctions due to minor violations. This indicates the high certainty in the regulatory system’s enforcement. In other words, once enrollees were found to have MIFA behaviors, they had a high probability of receiving a penalty.

Survey results from enrollees, presented in Appendix Table 3 and Figure 4, indicated that the perceived certainty of medical insurance regulation ranked second among all dimensions of the scale. The
certainty of the regulatory system received an average score of 4.436 (±0.777) out of 5, with a median score of 5. Additionally, an itemized analysis, shown in Appendix Table 4, revealed that the certainty of enforcement (4.436±0.823) was marginally higher than that of the certainty of detection (4.435±0.809).

Celerity of the regulatory system

The celerity of the basic medical insurance regulatory system, shown in Table 4, demonstrates that the average duration for the celerity of detection fluctuated around 218 days from 2017 to 2021. The data from 2017 to 2019 show minimal variation in detection times. However, the year 2020 exhibited a pronounced anomaly in the timeline, primarily due to the disruptions caused by the COVID-19 pandemic. Notably, the celerity of detection significantly improved in 2021, with the duration shortening to an average of 171 days.

Furthermore, the period for the celerity of enforcement, as shown in Table 4, maintained an average of approximately 29 days across the same timeframe. Over the five-year period, except for 2020, there was a gradual reduction in the average number of days for sanctions. The enforcement timespan showed considerable variability, with durations ranging from 0 to 1,420 days, indicating that certain cases experienced unduly prolonged penalty phases.

Survey findings on the enrollees’ perceptions of the regulatory system's celerity identified it as the lowest-ranked dimension among those assessed, with an average rating of 4.225 (±0.905) out of 5, and a median score of 4.5, as shown in Appendix Table 3 and Figure 4. Furthermore, an itemized analysis, shown in Appendix Table 4, revealed that the perceived celerity of detection (4.228±0.946) was higher than the perceived celerity of enforcement (4.222±0.944).

Table 4. Annual distribution of celerity of detection and enforcement from 2017 to 2021

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>Celerity of detection</th>
<th>Celerity of enforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average days</td>
<td>SD</td>
</tr>
<tr>
<td>2017–</td>
<td>12,898</td>
<td>217.8</td>
<td>101.48</td>
</tr>
<tr>
<td>2021</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>1,958</td>
<td>209.1</td>
<td>82.25</td>
</tr>
<tr>
<td>2018</td>
<td>3,153</td>
<td>228.1</td>
<td>95.02</td>
</tr>
<tr>
<td>2019</td>
<td>2,988</td>
<td>240.5</td>
<td>93.78</td>
</tr>
<tr>
<td>2020</td>
<td>799</td>
<td>350.2</td>
<td>117.29</td>
</tr>
<tr>
<td>2021</td>
<td>4,000</td>
<td>170.6</td>
<td>85.03</td>
</tr>
</tbody>
</table>

Examining the overall deterrence of the medical insurance regulatory system, the survey results showed that enrollees distinctly perceived its effectiveness. The mean deterrence score—integrating the aspects of severity, certainty, celerity, and subjective norms—was 4.379 (±0.675) on a 5-point scale. The median
Using data from the supervision of medical insurance enrollees and a representative survey conducted in Shanghai, China, this study delineates the deterrence experienced by enrollees within the country's basic medical insurance framework. To our knowledge, this study is the first investigation into the deterrence of medical insurance regulatory systems. Guided by deterrence theory, we dissected the deterrence of medical insurance regulation into three dimensions: severity, certainty, and celerity, to interpret its impact. Focusing on Shanghai as a case study, our findings illuminate the deterrence in the regulatory activities carried out by government regulators and the distinctive features of these regulatory arrangements.

This study developed an analytical framework based on deterrence theory, providing a comprehensive understanding of deterrence in medical insurance regulatory systems from a dual perspective: the system's inherent deterrence, and the perceived deterrence by enrollees. It reveals the complex interplay between the enforcement actions of the system and the perceptions of those it regulates, highlighting their mutual dependence. Our framework emphasizes the significance of considering both objective measures of regulatory enforcement and the subjective experiences of those regulated. Furthermore, our study suggests that a detailed analysis of the medical insurance regulatory system's deterrence could consider severity, certainty, celerity, and subjective norms, as these elements reflect the regulatory system's features. While previous studies have demonstrated the validity of deterrence theory in analyzing sanctions related to economic crimes\cite{31,32}, its application to medical insurance regulation has been rarely explored. Our study broadens the application of deterrence theory within the medical insurance field, laying the groundwork for deeper exploration of regulatory impact and the formulation of more targeted interventions.

We found that Shanghai’s basic medical insurance regulatory system significantly deterred the majority of enrollees, corroborating the establishment of deterrence in mitigating MIFA by regulation. This finding is consistent with the policy direction of medical insurance regulation in China, which aims to cultivate a highly deterrent environment characterized by “no courage to commit fraud, no capability to do so, and no wish to attempt it”\cite{33}. Notably, enrollees' perceptions of subjective norms were high, affirming the significant deterrent effect of the social environment's construction. However, our study also revealed that some enrollees perceived the deterrence of the regulatory system as weak. There are potential opportunities to enhance the overall efficacy of deterrence by improving the system's severity, certainty, and celerity.

Our study revealed that the basic medical insurance regulatory system in China enforced various and intensive measures, with perceived severity by enrollees scoring the highest among all dimensions evaluated. However, the predominance of single-type sanctions, and the limited differentiation in penalty
intensity for different offenses, constrained the effectiveness of regulation. This practice is consistent with many countries where administrative sanctions serve as the primary means for deterring MIFA\textsuperscript{[34]}. Nonetheless, previous research has indicated that the current scope of administrative sanctions might be inadequate for deterring fraudulent behavior\textsuperscript{[35]}. Some nations have implemented criminal sanctions and credit-based interventions to heighten the severity of penalties for MIFA\textsuperscript{[36,34]}. However, the absence of a collaboration mechanism to transition from administrative to criminal sanctions might undermine the effectiveness of such strategies, a challenge observed within China’s regulatory system\textsuperscript{[35]}. To enhance penalty severity, regulatory systems need to adopt more sophisticated strategies that combine administrative actions, credit-based interventions, and criminal sanctions, particularly targeting repeat offenders, to strengthen deterrence effectively.

This study also found a high level of regulatory certainty within Shanghai’s medical insurance system, encompassing both detection and enforcement efforts. Despite this, we observed that manual review and processing remain the primary regulatory methods. Identifying deliberately hidden fraudulent behaviors through current processes continues to pose a significant challenge. In light of international practices, adopting advanced data mining techniques and multivariate statistical methods presents a promising avenue to transcend the limitations of conventional regulatory approaches\textsuperscript{[37–39]}. Empirical studies have demonstrated that detection accuracies for MIFA using data mining-based models and multi-stage methodologies were notably high, exceeding 80\%\textsuperscript{[40,41]}. Integrating technology into the regulatory system offers a substantial opportunity to increase regulatory certainty. By transitioning from predominantly manual processes to more automated and data-driven approaches, the regulatory systems’ capability in combatting MIFA can be enhanced effectively.

Our study revealed significant delays and inconsistencies in the detection and enforcement of MIFA within medical insurance regulation in Shanghai, underscoring the necessity for efficiency improvements. The findings indicate that the review process for medical insurance regulation in China typically spanned about six months, with MIFA activities usually being addressed and penalized within one month. Survey data from insured individuals indicate that the perceived deterrence of regulatory celerity remains the weakest link. In contrast, developed countries with advanced regulatory systems often achieve real-time review and enforcement through automated screening systems, demonstrating more efficient approaches\textsuperscript{[42]}. Despite the incremental improvements observed in China’s regulatory timeline, international benchmarks revealed a significant gap in regulatory agility and efficiency. Previous literature suggests that leveraging information technology and standardizing regulatory procedures can enhance the levels of regulatory responsiveness\textsuperscript{[43,44]}. Therefore, enhancing efficiency through advanced technology, and establishing clear, precise regulations that outline the duties and processes of regulatory personnel are imperative for effectively resolving MIFA cases.

This study has several limitations. First, our study strived to analyze the certainty of detecting fraud and abuse within the regulatory systems by applying historical data on regulatory activities, and in-depth analysis of regulatory processes, and corroborating these with interview insights. However, it was unable
to ascertain the actual prevalence of fraud and abuse in the real-world. Therefore, our estimates regarding the certainty of detection were inherently based on approximations. Second, this study has a limitation in terms of temporal alignment of data sources. Conducted in 2022, our research relied on regulatory data pertaining to enrollees in Shanghai that were accessible only for the period from 2017 to 2021. Concurrently, the survey assessing enrollees' perceived deterrence was executed in 2022. In subsequent studies, we aim to acquire the latest regulatory data, which will allow for a more current and relevant assessment of the regulatory landscape and its impact on enrollees’ perceptions of deterrence. Third, in our analysis of the objective state of regulatory activities, we focused on the dimensions of severity, certainty, and celerity, while the impact of social norms was not explored. This was primarily due to the unavailability of concrete objective data to substantiate this aspect of the analysis, leading us to rely on individuals’ subjective responses. Further research should consider collecting more comprehensive information to reflect the status of social norms. We would gather more data from various stakeholders, such as healthcare professionals in medical institutions, and staff members of medical insurance regulatory bodies. These are important issues to be addressed in future research.

Conclusion

Our study confirms the strong deterrence of current regulatory schemes within basic medical insurance, yet identifies key areas for improvement. The current regulatory system's reliance on traditional administrative measures and manual detection techniques, along with the protracted response times, presents significant challenges. Enhancing the diversity of punitive measures, integrating advanced detection technologies, and accelerating response time are crucial for the system's overall effectiveness. Addressing these aspects will ensure better protection of the medical insurance fund and improve the health system's effectiveness.

Abbreviations

MIFA: Medical insurance fraud and abuse; UEBMI: Urban Employee Basic Medical Insurance; URBMI: Urban and Rural Residents Basic Medical Insurance; SMISII: Shanghai Medical Insurance Supervision and Inspection Institute; DMISE: Database of Medical Insurance Supervision on Enrollees; EPDS: Enrollees' Perceived Deterrence Scale; SD: Standard deviation.

Declarations

Ethics approval and consent to participate

The study was approved by the Medical Research Ethics Committee, School of Public Health, Fudan University. The reference number for the study is: IRB# 2022-5-0970.

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Consent for publication

Consent was obtained during the consent to participate stage for all participants.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to confidentiality agreements with the Shanghai medical insurance regulatory authority and ownership by the research team, but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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**Figures**

![Analytical Framework Diagram](image-url)

**Figure 1**

The analytical framework
Figure 2

Indicators of deterrence based on deterrence theory
Figure 3

The procedures of medical insurance regulatory review in Shanghai
Figure 4

Annual trend of detected MIFA cases from 2017 to 2021

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- 20240407SupplementaryAppendix.docx