




## Policy Options for Reducing Defensive Medicine Behaviors: A Multi-Method Study

Ehsan Zarei<sup>1</sup>, Iman Yousefi<sup>2</sup>, Saba Shiranirad<sup>3</sup>, Tahmineh Poursaki<sup>1</sup>, Mohamad Mehdi Zahmatkesh<sup>4</sup>, Pouria Farrokhi<sup>5\*</sup> 

Received: 23 Mar 2023

Published: 29 Jul 2024

### Abstract

**Background:** Defensive medicine (DM) refers to taking or not taking clinical actions, mainly to prevent legal or reputational consequences. It increases patient and health system costs and threatens patient safety. This study aimed to provide policy options to reduce DM behaviors and was conducted in two phases.

**Methods:** First, a scoping review was conducted by searching the Web of Science, PubMed, ProQuest, and Scopus databases in 2000–2023, and interventions and strategies to control DM behaviors were identified. To recognize the advantages, disadvantages, and implementation considerations, one session of focus group discussion (FGD) with experts was designed. Finally, the policies, strategies, advantages, disadvantages, and implementation considerations were refined and categorized during two expert panel sessions.

**Results:** During the search, 1774 articles were retrieved. Finally, after the screening process, 58 articles were included in the study. Four main policy options were formulated: "evidence-based medicine," "legal reforms," "promotion of professional ethics and a supportive environment," and "improving the doctor-patient relationship." In the following, 13 interventions and strategies, 18 advantages, 18 disadvantages, and 21 implementation considerations were identified.

**Conclusion:** To manage and reduce the effects of DM behaviors, different interventions at macro, organizational, and individual levels are needed. At the micro and individual levels, the enhancement of knowledge and skills is valuable. Organizational interventions that create a supportive culture and promote ethical behavior are also important.

**Keywords:** Defensive Medicine, Defensive Practice, Conflict Of Interest, Medical Malpractice, Lawsuits

**Conflicts of Interest:** None declared

**Funding:** None

*\*This work has been published under CC BY-NC-SA 1.0 license.*

Copyright© Iran University of Medical Sciences

**Cite this article as:** Zarei E, Yousefi I, Shiranirad S, Poursaki T, Zahmatkesh MM, Farrokhi P. Policy Options for Reducing Defensive Medicine Behaviors: A Multi-Method Study. *Med J Islam Repub Iran.* 2024 (29 Jul);38:86. <https://doi.org/10.47176/mjiri.38.86>

### Introduction

Medical science should be used to provide services and improve patients' health. Doctors are obliged to use their skills to advance the interests of patients' health instead of promoting personal interests. The doctor-patient relationship is often considered a fiduciary relationship; doctors should put the interests of patients above their own and provide services considering the patient's best interests. But defensive medicine (DM) is the opposite of these basic eth-

ical obligations (1). DM refers to performing or not performing clinical actions, mainly to prevent legal or reputational consequences (2). These actions may be negative or positive. Negative actions refer to avoiding the admission of high-risk patients or not performing high-risk procedures, and positive actions include unnecessary referrals, unnecessary hospitalization, late discharge, unnecessary diagnostic tests, and prescribing unnecessary drugs (3).

**Corresponding author:** Pouria Farrokhi, [p-farrokhi@student.tums.ac.ir](mailto:p-farrokhi@student.tums.ac.ir)

<sup>1</sup> Department of Health Service Management, School of Public Health and Safety, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>2</sup> School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>3</sup> School of Pharmacy, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>4</sup> School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>5</sup> Department of Health Management, Policy and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

#### ↑What is "already known" in this topic:

The problem of defensive medicine can lead to poor quality, limited access, higher costs, and negative results for patients and the health system. Several descriptive cross-sectional studies were performed to investigate the prevalence rate, reasons, and solutions to reduce defensive medicine in Iran.

#### →What this article adds:

For the first time, this study investigated the current policy approaches for reducing defensive medicine behaviors globally and provided an analysis of the advantages, disadvantages, and implementation issues in Iran.

The goal of the DM is to protect the physician from adverse outcomes that conflict with the physician's professional, ethical, and fiduciary obligations. While a doctor's decision-making should be based on the patient's best interests, a powerful set of doctors' interests influence their decision-making. Prioritizing doctors' interests over patients' interests, exposing patients to avoidable harm, and misallocating scarce healthcare resources is against medical ethics (1). In the professional code of ethics of the Medical Council of Iran, the priority of the patient's interests is emphasized over any other interest, and the unnecessary actions of the doctor to defend himself against the possible patient's complaint are not recognized as moral.

DM is widely practiced worldwide and is not limited to a specific country (4, 5). According to a systematic review, the overall prevalence of DM has been reported to range from 6.7 to 99.8% globally, with the highest percentage, 99.8%, belonging to Iran (6). Studies show that the prevalence of DM behaviors is high among general physicians (7), surgeons (3), and medical residents (8) in Iran, and almost all of them perform at least one of the DM behaviors.

Fear of litigation (1, 2, 5, 6, 9, 10), concern about the negative consequences of complaints (1, 6, 9, 10), increasing liability insurance premiums (3, 6), insufficient organizational protections for doctors in cases of malpractice (6, 11), organizational culture that blames medical errors (5, 9), low experience and confidence (5, 6, 10) and lack of commitment to medical ethics (1, 6) are important reasons for the prevalence of DM.

Among the adverse consequences of DM, we can mention the violation of independence, professional and fiduciary obligations of doctors, violation of patient safety (12, 13), weakening of public trust and justice in the use of resources (14), negative impact on the quality and access of health care (1) and most importantly imposing unnecessary costs on the health system and wasting financial and non-financial resources (12). In Italy, 10% of national health costs are attributed to DM (15), also 14% of total drug costs, 23% of total laboratory test costs, and 25% of total imaging costs per person are unnecessary and due to DM (16). The cost of DM in the United States was estimated at 55.6 billion dollars, equal to 2.4% of the total health expenditures (17).

The extensive negative consequences of DM have caused it to be raised as an important concern in health policymaking, and policymakers are looking for effective strategies to manage it (18). Although DM is a recognized problem in the developed world and has been for several decades, developing countries, including Iran, are not as familiar with

this phenomenon. Additionally, the prevalence of specific activities among Iranian doctors, like prescribing unnecessary medicines and referring patients to specialists, indicates that this issue occurs frequently (7). In Iran, Positive and negative DM among surgeons were reported by Ash-tarnakhaee et al. to be 100% and 80%, respectively (19). Furthermore, among general practitioners, positive and negative DM were reported by Amiresmaili et al. to be 99 and 47 percent, respectively (20). It is required to reduce and manage this phenomenon as a result. The DM in Iran's health system has received little attention, and there need to be guidelines or comprehensive policies for management and control. Therefore, the present study is the first to identify policy strategies and interventions for DM management and reduction in Iran.

**Methods**

This study was conducted in two phases: (1) scoping review, (2) focus group discussion (FGD), and expert panel. The scoping review was conducted based on the Arksey and O'Malley framework (21). Also, the preferred reporting items for the systematic reviews and meta-analyses extension of the scoping review checklist (PRISMA-ScR) were used in the retrieval process.

**Phase 1: Step 1. Identifying the research question**

What are the strategies and interventions to reduce defensive medicine (DM) among physicians in Iran?

**Step 2. Identifying relevant studies**

The time frame of the search was considered to be from January 1st, 2000, to July 30th, 2023. Publications were searched in international databases, including Web of Sciences, PubMed, ProQuest, and Scopus. Using MeSH headings, we searched for the terms “defensive medicine”, “defensive practice”, solution, intervention, polic\*, strateg\*, legislat\*, suggestion, recommendation, guideline, approach, and law (Appendix 1). The full search strategy in PubMed is highlighted in Table 1, which was adapted to other databases.

**Step 3. Selecting studies**

The following criteria were considered for the selection of articles: (1) first, DM was an important part of their purpose; and second, at least one policy, intervention, or strategy was proposed or discussed; (2) all types of articles, such as letters, reviews, and originals, except conference articles and book chapters; (3) in English; (4) studies whose target population was physicians; and (5) articles whose

Table 1. Search strategy used in PubMed

Data-base	Set	Search Strategy	Records (No)
PubMed	#1	MeSH Title & Abstract	“Defensive medicine” 1,657
	#2	Title & Abstract	“Defensive medicine” OR “Defensive practice” “Solution” OR “Intervention” OR “Polic*” OR “Strateg*” OR “Legislat*” OR “Suggestion” OR “Recommendation” OR “Guideline” OR “Approach” 4,894,892
	#3		#1 AND #2 317
	#4		Filters: English, from 2000-2023 208

full text was available. All retrieved records were entered into EndNote X9 software. Duplicate articles were removed. For both abstract and full-text screening, two independent reviewers (EZ and IY) selected studies by title and abstract/full text, and the third reviewer (PF) resolved disagreements. The full text of the relevant articles for our study was prepared for data extraction.

#### Step 4. Charting the Data

Each article was read by two authors independently, and appropriate strategies/ interventions were extracted. It was then discussed by the team members and entered into the data form with an agreement. Additionally, the Critical Appraisal Skills Program (CASP) checklist was used to assess the quality of the qualitative and systematic review studies. There were ten questions on this checklist; the first two were screening questions, to which appropriate responses were "yes" and "no." After the first two questions, if the response was "yes," then the article will be assessed further. The evaluator chose one of the three answers—"yes," which received a score of 3, "no," which received a score of 1, or "cannot say" (a score of 2)—for each of the eight questions that followed. Article scores ranged from 8 to 24, with 24 being the maximum. Studies that had papers with scores less than 16 were not included (22, 23). The 22-item Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was also used to assess the quality of the cross-sectional studies. A score between 0 and 7 was considered low quality, 8 and 17 as moderate, and 18 and 22 as high quality (24). The characteristics of the studies, such as author, year of publication, source of publication, type of study, and quality appraisal score, were entered in a table (Appendix 2). Strategies/ interventions were also presented in another table (Table 2).

#### Step 5. Collate, summarize, and report results

The authors identified themes in the literature by reading and discussing each article included. Articles were then coded independently by two authors. All authors discussed each code and grouped codes into final themes. The content analysis method was applied to the data analysis. In this step, the main components of the examined articles were

organized. Data were combined and interpreted by filtering, organizing, and categorizing components following the main research questions. The results were categorized into distinct extraction codes and a theme framework based on study codes.

#### Phase 2: FGD & Expert panels

According to the study by Nyumba et al., FGD comprises four main steps. These consist of the following: (1) research design, (2) data collection, (3) analysis and (4) reporting of results (25).

##### Step 1. Research design

The FGD was conducted with the aim of identifying appropriate policies and interventions to reduce the prevalence of DM behaviors in Iran's health system. The FGD session included two main questions: 1. What policies and regulations do you believe the health authorities should be focusing on to reduce DM behavior? 2. What interventions at the individual, organizational, and health system levels can reduce defensive medicine? Getting a consent form, obtaining permission to record the conversation, clarifying the goals of the study, and ensuring that the data will only be used for this study, as well as giving participants the right to withdraw at any time throughout the study, were ethical concerns of the research at this stage. By using a purposeful sampling method (26), experts in the field of medical ethics working in the hospital (6 people) and the Ministry of Health (one person) were selected. The participants were invited by telephone and in person. Including and excluding criteria for experts selecting included (1) having a work experience of at least 8 years, (2) having two scientific articles in the field of medical ethics and (3) having a certificate of specialization course (Table 2).

##### Step 2. Data collection

The FGD session was held in the Department of Health Service Management, School of Medical Education and Management, Shahid Beheshti University of Medical Sciences. The FGD was conducted in a room with adequate space, a round table, and working air conditioning. The re-

Table 2. Inclusion and exclusion criteria of the study

Inclusion criteria	Exclusion criteria
Scoping review <ul style="list-style-type: none"> <li>Articles whose DM was an important part of their purpose.</li> <li>At least one policy, intervention, or strategy was proposed or discussed.</li> <li>All types of articles, such as letters, reviews, and originals, except conference articles and book chapters</li> <li>In English</li> <li>Studies whose target population was physicians</li> <li>Articles whose full text was available</li> <li>Published from 2000 to 2023</li> </ul>	<ul style="list-style-type: none"> <li>Studies that did not mention any strategies, policies, or interventions to reduce DM.</li> <li>Articles published in languages other than English.</li> <li>Articles published before 2000</li> <li>Articles that were not available</li> </ul>
FGD & Expert panels <ul style="list-style-type: none"> <li>Having a work experience of at least 8 years.</li> <li>Having two scientific articles in the field of medical ethics.</li> <li>Having a certificate of specialization course.</li> </ul>	<ul style="list-style-type: none"> <li>Work experience of less than 8 years</li> <li>Not having two scientific articles in the field of medical ethics.</li> <li>General practitioners</li> <li>Unwillingness to participate</li> </ul>

searcher, who oversees the entire project (EZ), started interviewing and led the meeting (FGD duration was 120 min). After asking each participant to provide a brief introduction, the primary questions that had been prepared previously were asked. With the participant's consent, the entire session was recorded. One of the researchers who was knowledgeable about the subject and the outcomes from the earlier phase was in charge of taking notes during the recording (PF). There were follow-up questions after the primary ones. Ultimately, the facilitator clarified and double-checked the items provided throughout the meeting and then acknowledged the participants for participating in the research.

**Step 3. Analysis**

The content-analysis method was used for data analysis, which finds, analyzes, and reports patterns (themes) within the text. When there are few theories available on the subject, this type of analysis is employed. The following procedures were used for data analysis and coding: familiarizing the data text; finding and extracting the fundamental codes; identifying themes; completing and reviewing the themes; naming and defining themes; recoding and renaming some classes and themes; and verifying the validity of

the codes (27, 28).

**Step 4. Reporting of results**

After analyzing the data, the results were shared with the participants (response validity). Response validity was employed to ensure the accuracy and rigor of the findings. Following each interview and FGD session, the participants' statements were summarized, and they were instructed to verify the validity of the findings (25).

After identifying advantages, disadvantages, and implementation considerations, factors based on strategies were refined and categorized through expert panels. To manage the conversation for 40-60 minutes, the expert panel was conducted in two face-to-face sessions with the meeting coordinator and leader. The opinions of experts were recorded and used by the research team to merge, add, and remove factors. Additionally, data transferability and reliability from expert checks, peer reviews, and immersion were used in this step to ensure rigor (29).

**Results**

**Results of Phase 1: scoping review**

As a result of the search, 1774 articles were retrieved; af-

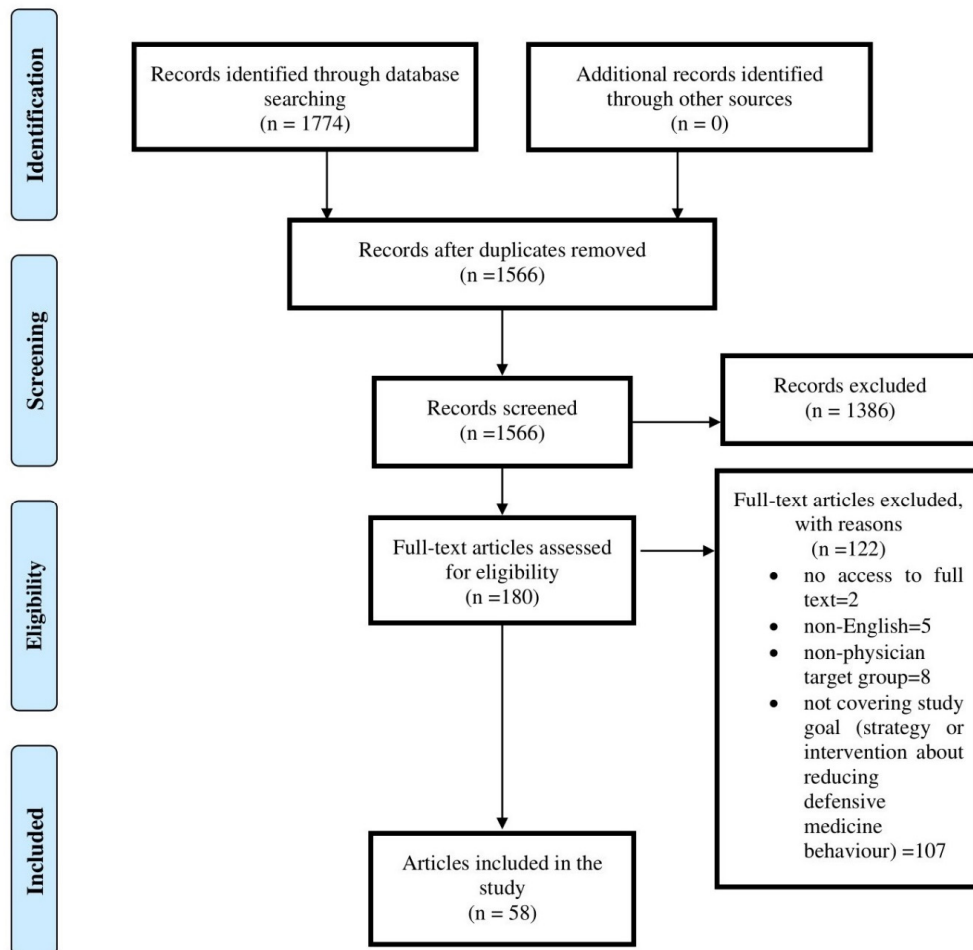


Figure 1. PRISMA-ScR flowchart of literature review

ter removing duplicate titles (285 articles), two team members independently reviewed the title and abstract of the remaining articles, which resulted in the selection of 208 articles. After reviewing the full text, 58 articles suitable for the study topic were identified (Figure 1). Of the 58 articles, 45% (N= 26) were original, and 55% (N= 32) were reviewed (e.g., systematic reviews). Most of the articles were published between 2015 and 2023. Articles were imported from 18 countries; 43% were from the USA, and then 15% from Italy. Three articles from Iran were included in the review. Table S1 (Appendix 1) shows the included articles' characteristics. In this phase, all policies, strategies, interventions, actions, advantages, disadvantages, and implementation considerations were extracted from articles.

### Results of Phase 2: FGD & Expert panels

FGD was done with the seven eligible experts. According to the demographic characteristics, two of the specialists were female, with an average age of 58.8 and work experience of 10.7 years. In this phase, 45 items were identified. Eventually, after eliminating and merging similar items, factors were reduced to 41 items. Additionally, finalized items in the scoping review and FGD stages, after removing duplicates and merging similar items in round table discussion, were checked. Finally, during two face-to-face sessions, 7 items were repetitive (based on a literature review), and 34 items remained, including 7 advantages, 9 disadvantages, and 18 implementation considerations. Based on the viewpoint of experts, four main policies (dimensions) were selected and strategies and interventions were divided among them; “evidence-based medicine” (3, 8, 9, 11, 14, 30-40), “legal reforms” (3, 8, 9, 12, 15, 18, 35, 37, 41-57), “promotion of professional ethics and supportive environment” (3-5, 8, 9, 13, 33, 39, 58-68), and “improving the doctor-patient relationship” (4, 8, 9, 16, 32, 62, 66, 69-71) (Figure 2). A total of 18 advantages, 18 disadvantages and 21 implementation considerations for the policies were found. The lowest number of advantages (n= 3) and the

highest number of disadvantages (n= 6) were related to the “legal reform” policy (Table 3).

### Discussion

This study aimed to provide policy options to reduce DM behaviors in Iran's health system, and four policy options were proposed. In this section, we have discussed policy options, emphasizing their implementation considerations.

#### 1- Use of evidence-based medicine (EBM)

In some studies, physicians' informed use of the best available evidence for clinical decision-making has been stated as the best policy to reduce DM (15, 39). Clinical practice guidelines (CPG) are a tool to improve the effectiveness and quality of health care (34), reduce variation in clinical practices, and prevent side effects, medical malpractice claims, and DM behaviors (11, 38). The use of CPGs in many countries, including the United States and Italy (11), has positively reduced DM. However, there are challenges in developing and monitoring their implementation and success rate. Their successful implementation requires a correct understanding of the executive obstacles of supervision and its correct implementation; otherwise, it will lead to low compliance of doctors and, as a result, a lack of desired effect (75). The development and use of CPGs have been emphasized in Iran's general health policies, but studies show that the number of developed CPGs in Iran is limited (76).

Along with the development of CPGs, there should also be a plan for their implementation (77). With the help of electronic health records, rules can be set so that providers behave according to CPG. In a study, medical residents believed that the patient's clinical information recording system could prevent the occurrence of DM to a great extent (8). In Iran, scattered activities have been carried out in the field of patient clinical information recording systems. Still, studies show there have always been obstacles to achieving

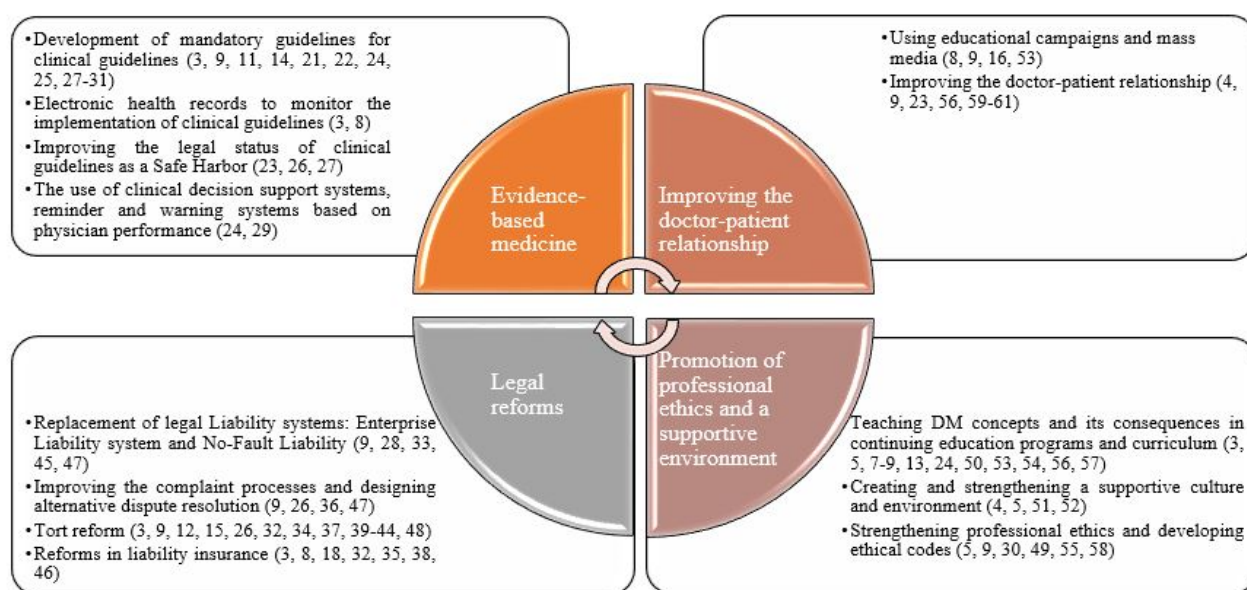


Figure 2. Policies and interventions/ strategies to control and manage DM behaviors

Table 3. Policies, advantages, disadvantages, and implementation considerations

Policies	Advantages (n= 18)	Disadvantages (n= 18)	Implementation considerations (n= 21)
Evidence-based medicine	✓ Improving the efficiency, availability, and affordability of healthcare services (34)	✓ The impossibility of developing the same guidelines for all cases of the disease (34)	✓ Developing policies for the development, publication, and implementation of guidelines
	✓ Regular access and recording of patient clinical information (8)	✓ Requires multiple updates	✓ Drawing a road map, developing the infrastructure, and implementing the clinical information registration system
	✓ Standardization of treatments and reducing the risk of complaints from doctors (14, 38)	✓ Unclear distinction between appropriate and inappropriate care in many clinical situations (15)	✓ User-friendly, physician-oriented, and simple design of decision support systems
	✓ The most effective method to reduce DM (39)	✓ Doctors' lack of trust in the protective effect of guidelines (36)	✓ Computer training in the curriculum and continuing education programs
	✓ Preventive approach	✓ Lack of awareness, sense of responsibility, and low acceptance and compliance of guidelines by doctors (31, 37)	✓ Creating non-financial incentives to increase the compliance of doctors ✓ Evidence-based medical education
Legal reforms	✓ Reducing unnecessary prescriptions and health system costs (9, 53)	✓ Politically challenging (32)	✓ Development of policies for the management of frivolous complaints, quick handling, transparency, and impartiality in the processes of handling complaints (36, 45)
	✓ Successful experience in other countries (39)	✓ Time-consuming and requires the coordination of many organizations	✓ Creation of specialized courts
	✓ Sustainable effect	✓ Uncertainty of complications and long-term consequences (42)	✓ Attracting opinions and extensive lobbies with influential institutions such as the Parliament and the Judiciary
		✓ Lack of influence on unnecessary prescriptions due to patient preferences (53)	✓ Negotiating with insurance companies to increase liability obligations
		✓ Increasing the willingness of doctors to perform fearless treatments	
Promotion of professional ethics & supportive environment	✓ Preventive approach	✓ Reluctance of insurance companies to increase the liabilities and reduce the premium (41)	
	✓ Low costs	✓ Time-consuming (55)	✓ Creating a supportive environment and institutionalizing a culture of learning from mistakes instead of blaming and warning (14, 33)
	✓ Institutionalization of professional ethics	✓ No effect on lawsuits caused by possible unavoidable consequences in the treatment process (55)	✓ Supporting doctors in lawsuits (for example, providing a lawyer)
	✓ Sustainability and long-term effect	✓ Influenced by the conditions and socio-cultural context of the environment	✓ Academic and continuing education programs
	✓ Increasing the knowledge of doctors and familiarity with low-cost alternative measures (33, 67)		✓ Developing ethical codes and guidelines ✓ Changing organizational culture

its goals (77). Also, studies show that the use of clinical decision support systems (CDSS) has a positive effect on compliance with CPGs (33, 38). The use of reminder and warning systems can help to reduce medical errors and consequently reduce DM.

Improving the legal status of clinical guidelines as a safe harbor can lead doctors to comply with them. Compliance with CPG should protect the doctor from legal claims and thus reduce DM (32, 36, 37). Legislators in Iran have expressed their support for doctors under certain circumstances and exempted them from responsibility, but there is no direct reference to using clinical guidelines. Priorities

appear to be making sure that clinical guidelines are followed, reinforcing the systems for recording and analyzing patient data in Iran.

### 2- Legal reforms

Studies in most countries, including Iran, show that "fear of lawsuits" is the most important reason for DM actions by doctors (8). Changing the legal responsibility systems of doctors and moving towards "enterprise liability" and "no-fault liability" can be an effective way to reduce DM. The characteristic of the enterprise liability system is that the

Table 3. Continued

Policies	Advantages (n= 18)	Disadvantages (n= 18)	Implementation considerations (n= 21)
Improving the doctor-patient relationship	✓ Increasing patient and doctor satisfaction (72, 73)	✓ Needs various measures to influence the doctor and the patient	✓ Determining and observing the standard visit time
	✓ Improving disease management, more appropriate and efficient use of health services, and patient compliance with the treatment plan (74)	✓ Patient confusion caused by increased information and interaction with the doctor	✓ Improving the hospital environment and patient privacy
	✓ Increasing patient safety (70, 72)	✓ Time-consuming	✓ Education on patients' rights
	✓ Increasing empathy between doctor and patient (72)	✓ Influenced by socio-cultural conditions	✓ Creating a doctor's standard working environment
	✓ Improving trust and better interaction between doctor and patient		✓ Improving patient and doctor communication skills (69)
			✓ Launching patient education campaigns

doctor will no longer be responsible alone, and this responsibility will be transferred to the institution/hospital where the doctor works. As a result, the mental pressure will be removed from the doctor and reduce DM (37). "No-fault liability system" in Norway, Finland, Sweden, and the USA has had successful experience in reducing DM (32, 42). To reduce DM, it may be necessary to amend the laws regarding doctors' liability, the complaint investigation system, and regulations that shift from being individual-oriented to organization-oriented.

Modifying complaint investigation processes (alternative dispute resolution) can reduce DM effectively. In a study with the participation of 11,000 doctors in the United Kingdom, modifying the complaints investigation processes to become more transparent, impartial, and efficient was recognized as an effective solution to reduce DM (45). Using alternative dispute resolution leads to informality and lower costs. This method uses volunteers instead of a jury to judge medical malpractice (37). Doctors think this method is fairer than the traditional method, and because of its informality, they do not worry about damaging their image. However, the definitive effects of this method still need to be completely clear. Another measure is to deal with medical malpractice lawsuits in specialized medical courts (18, 36). Apology laws have also been enacted in several US states, allowing doctors to apologize for mistakes or poor results without going to court. An apology reduces the patient's anger, maintains his trust, and thus reduces complaints (36).

Tort reform in different countries was an important step toward managing DM and reducing its consequences (12, 35, 41, 43, 48, 50-52). "Non-economic and punitive damage caps" (49), "Capping attorney fees" (36), and "Collateral source rule" (47), were among the measures that should be approved and implemented after adapting to the structure of the country's legal system.

Liability insurance plays an important role in protecting doctors and reducing their fear. Various studies have stated the positive effect of liability insurance in reducing DM (18, 55). The existence of liability insurance only partially prevents DM, but evidence shows its impact on reducing referrals to specialists, hospitalization, surgery, and imaging (41). In a study on Iranian surgeons, weak support and high premiums as one of the main reasons for taking DM measures were stated by doctors (3). One of the solutions is

to pay the insurance premium to the organization or the government. For example, doctors in England are covered by insurance by the NHS and do not need to pay insurance premiums (78), so they are much less exposed to lawsuits (79). With liability insurance in place, physicians can focus on providing appropriate care without the constant fear of being sued for every decision. This allows them to avoid ordering excessive tests or treatments that are not medically necessary.

### 3- Promoting professional ethics and a supportive environment

The medical profession has traditionally relied on self-regulatory tools such as codes of ethics to enforce ethical standards and protect patient interests. Organizations should also support doctors who prioritize the patient's interests and refrain from providing low-value care and taking DM actions (5). Combating DM requires strengthening the moral values of doctors (39). Developing ethical codes and systemic reforms in medical culture to reduce DM measures (9) through strengthening moral values are two important approaches in this field. In Iran, the Medical Council has tried to develop professional ethics codes, but there is a need for a more complete guide.

Improving legal knowledge is useful to increase doctors' confidence in their decision-making and to ensure that the law operates based on rational criteria and that any negative result does not mean medical malpractice (5). Education can also give clinicians a realistic awareness of legal risks and counter exaggerated fears that cause DM (5, 9). Strengthening professionalism and understanding of legal and ethical responsibilities, such as obtaining patient consent, which includes adequate patient information about treatment options, risks, and benefits, should be strengthened through education (9). Evidence shows that the use of persuasive educational messages has been effective in reducing unnecessary diagnostic procedures (80). Studies have shown that increasing students' knowledge and training regarding the value of prescription, diagnostic tests, and evidence-based medicine has reduced unnecessary services (62). Also, many doctors need more information about DM and appropriate briefing and training sessions in continuing education programs and professional meetings (59).

Studies show that environments that promote ethical behavior and a supportive culture play an important role in

controlling DM. Physicians should be able to seek colleagues' opinions, especially in difficult clinical cases, and make collaborative decision-making (8). They need opportunities to discuss issues with colleagues when problems arise (5). Organizations should also support doctors through their actions. If a hospital takes initiatives to reduce low-value care, it should also support physicians who face lawsuits. Evidence shows that the fear of colleagues' blame is a more important factor than the fear of patients' complaints in the occurrence of DM. The existence of macro and organizational policies that reduce peer criticism is necessary to reduce DM by physicians (5). In the "Just culture," there is no fear of doctors being blamed by colleagues, and instead, collective learning and safe and valuable care are promoted (5). Therefore, it is necessary to move from the punitive approach to identifying and correcting structural errors and promoting a supportive culture (4, 9). Organizations should also take timely and fair mechanisms to support doctors when patients complain (15). It can be stated that medical professionals are more inclined to concentrate on delivering high-quality care rather than engaging in DM when they feel valued and supported in their workplace. The reason for this change is that a supportive culture encourages honest dialogue, mutual trust, and teamwork among healthcare professionals, which can improve decision-making and reduce lawsuit concerns.

#### 4- Improving the doctor-patient relationship

One of the approaches to reduce DM is the patient's active participation and interaction with the doctor to make decisions about unnecessary care (81). Various studies have emphasized improving the doctor-patient relationship as one of the ways to reduce lawsuits and consequently reduce DM (4, 5, 9, 39, 69, 81). These are often indirect interventions that can affect the doctor, the patient, or both (71). Appropriate workload, improving teamwork, strengthening doctor's communication skills, increasing examination duration, continuity of care, patient participation in the treatment process, and improving the service delivery environment are among the interventions that can lead to the improvement of the doctor-patient relationship (5, 8, 39, 70, 72).

Patient pressure on doctors to prescribe unnecessary services can lead to the adoption of the DM approach in doctors. Studies have shown that community education regarding unnecessary diagnostic procedures has positively affected doctors' behavior and better patient communication (16). A successful example of these campaigns under the title "Choosing Wisely," which deals with the simultaneous awareness of patients and doctors, has been implemented in 13 countries so far and, in cooperation with professional medical associations, publishes resources to inform patients and doctors on various issues (9, 16, 82). In summary, improving the doctor-patient relationship through increased trust, communication, shared decision-making, and reduced fear of litigation can help reduce the practice of DM and lead to more efficient and cost-effective healthcare.

#### Limitations

One of the limitations of the present study was the participation of only Iranian experts and also the literature review, which was limited to English language articles, which could reduce the generalizability of the results. Moreover, it is possible that the meeting facilitator unintentionally caused limited opinions during the FGD or that the majority's viewpoint overwhelmed the minority's. As a result, some items may not have been mentioned in the meeting.

#### Conclusion

DM has received less attention in Iran, while its effects are significant due to increased costs and the threat to patient safety. The proposed policies from this study and their advantages, disadvantages, and implementation considerations are evidence-based and up-to-date, which can help policymakers use them to reduce DM-related behaviors. There is a need for intervention at different macro, organizational, and micro levels to manage and reduce the effects of DM. Interventions at the micro and individual levels to enhance knowledge and skills are valuable. Still, organizational interventions and environments that create a supportive culture and promote ethical behavior are also important. Legal interventions should also be done at the macro level. A combination of the following actions has better effectiveness in reducing the negative effects of DM: first, focusing on informing patients and doctors and promoting professional ethics guidelines, and then, in the long term, making legal reforms and focusing on promoting evidence-based medicine.

#### Authors' Contributions

EZ and PF designed the study; EZ, IY, and TP screened and selected the studies; TP and SS extracted the data; PF, SS and MZ conducted FGD and expert panel sessions; EZ, IY, and MZ drafted the manuscript; EZ, TP, and SS modified the final manuscript; and all authors: read and approved the final manuscript.

#### Ethical Considerations

Not applicable.

#### Acknowledgment

Not applicable.

#### Conflict of Interests

The authors declare that they have no competing interests.

#### References

1. Bester JC. Defensive practice is indefensible: how defensive medicine runs counter to the ethical and professional obligations of clinicians. *Med Health Care Philos.* 2020;23:413-20.
2. Strobel CJ, Oldenburg D, Steinhäuser J. Factors influencing defensive medicine-based decision-making in primary care: A scoping review. *J Eval Clin Pract.* 2023;29(3):529-38.
3. Daneshkohan A, Ashtar-Nakhaei F, Zali A, Kakemam E, Zarei E. Defensive medicine and its related risk factors: evidence from a sample of Iranian surgeons. *Hosp Pract.* 2023;51(2):101-6.
4. Vento S, Cainelli F, Vallone A. Defensive medicine: It is time to finally slow down an epidemic. *World J Clin Cases.* 2018;6(11):406-9.

5. Ries NM, Johnston B, Jansen J. A qualitative interview study of Australian physicians on defensive practice and low value care: "it's easier to talk about our fear of lawyers than to talk about our fear of looking bad in front of each other". *BMC Med Ethics*. 2022;23(1).
6. Kakemam E, Arab-Zozani M, Raeissi P, Albelbeisi AH. The occurrence, types, reasons, and mitigation strategies of defensive medicine among physicians: a scoping review. *BMC Health Serv Res*. 2022;22(1).
7. Moosazadeh M, Movahednia M, Movahednia N, Amiresmaili M, Aghaei I. Determining the frequency of defensive medicine among general practitioners in Southeast Iran. *Int J Health Policy Manag*. 2014;2(3):119.
8. Vafaei Najar A, Rezaei AA, Esmaily HA, Dogonchi M, Hooshmand E. Survey of the causes and solutions to reduce defensive medicine in view of residents in mashhad university of medical sciences in 2016. *J Healthc Manag*. 2016;7(2):21-30.
9. Ries NM, Jansen J. Physicians views and experiences of defensive medicine: An international review of empirical research. *Health Policy*. 2021;125(5):634-42.
10. Baungaard N, Skovvang PL, Hvidt EA, Gerbild H, Andersen MK, Lykkegaard J. How defensive medicine is defined in European medical literature: a systematic review. *BMJ open*. 2022;12(1):e057169.
11. Zerbo S, Malta G, Argo A. Guidelines and Current Assessment of Health Care Responsibility in Italy. *Risk Manag Healthc Policy*. 2020;13:183-9.
12. Antoci A, Maccioni AF, Russu P, Sacco PL. Curing is caring? Liability reforms, defensive medicine and malpractice litigation in a post-pandemic world. *Socio-Econ Plan Sci*. 2022;80.
13. Cervellini G, Cavazza M. Defensive medicine in the emergency department. The clinicians' perspective. *Emerg Care J*. 2016;12(1):20-2.
14. Tuers DM. Defensive medicine in the emergency department: increasing health care costs without increasing quality? *Nurs Adm Q*. 2013;37(2):160-4.
15. Panella M, Rinaldi C, Leigheb F, Donnarumma C, Kul S, Vanhaecht K, et al. The determinants of defensive medicine in Italian hospitals: The impact of being a second victim. *Revista De Calidad Asistencial*. 2016;31:20-5.
16. Pellino IM, Pellino G. Consequences of defensive medicine, second victims, and clinical-judicial syndrome on surgeons' medical practice and on health service. *Updates in Surgery*. 2015;67(4):331-7.
17. Mello MM, Chandra A, Gawande AA, Studdert DM. National Costs Of The Medical Liability System. *Health Aff*. 2010;29(9):1569-77.
18. Kucuk M. Defensive medicine among obstetricians and gynaecologists in Turkey. *J Obstet Gynecol*. 2018;38(2):200-5.
19. Ashtarnakhaee F, Zarei E, Daneshkohan A, Zali A. The Prevalence of Defensive Medicine Behaviors among Surgeons, Its Causes and Potential Reduction Solutions: a Cross-Sectional Study in Iran. *jmciri*. 2017;35(4):309-17.
20. Amiresmaili M, Nekouimoghadam M, Moosazadeh M, Esmaily F, Mirtajeddini M. A Survey On Frequency Of Defensive Medicine Among General Practitioners Of Kerman City. *Payavard-Salamt*. 2014;7(5):399-409.
21. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8(1):19-32.
22. Ma LL, Wang YY, Yang ZH, Huang D, Weng H, Zeng XT. Methodological quality (risk of bias) assessment tools for primary and secondary medical studies: what are they and which is better? *Mil Med Res*. 2020;7(1):7.
23. Critical Appraisal Skills Programme (CASP) 2024 [Available from: <https://casp-uk.net/casp-tools-checklists/>].
24. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *Int Surg J*. 2014;12(12):1495-9.
25. O. Nyumba T, Wilson K, Derrick CJ, Mukherjee N. The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and evolution*. 2018;9(1):20-32.
26. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm. Policy Ment. Health*. 2015;42:533-44.
27. Grbich C. Qualitative data analysis: An introduction. *Qualitative Data Analysis*. 2012:1-344.
28. Pope C, Ziebland S, Mays N. Qualitative research in health care: Analysing qualitative data. *BMJ Br Med J*. 2000;320(7227):114.
29. Cypress BS. Rigor or reliability and validity in qualitative research: Perspectives, strategies, reconceptualization, and recommendations. *Dimens Crit Care Nurs*. 2017;36(4):253-63.
30. Austad B, Hetlevik I, Mjølstad BP, Helvik AS. Applying clinical guidelines in general practice: a qualitative study of potential complications. *BMC Fam Pract*. 2016;17.
31. Blume LHK, van Weert N, Busari JO, Stoopendaal AMV, Delnoij DMJ. What hospitals need to know about guidelines: A mixed-method analysis of guideline implementation in Dutch hospitals. *J Eval Clin Pract*. 2017;23(6):1266-73.
32. Carrier ER, Reschovsky JD, Katz DA, Mello MM. High Physician Concern About Malpractice Risk Predicts More Aggressive Diagnostic Testing In Office-Based Practice. *Health Aff*. 2013;32(8):1383-91.
33. Chawla A, Gunderman RB. Defensive medicine: Prevalence, implications, and recommendations. *Acad Radiol*. 2008;15(7):948-9.
34. Cláudia Sá Dos R, Bennett C, Sun Z. Education and training as a strategy to improve justification of medical imaging referrals in emergency departments. *J Med Radiat Sci*. 2018;65(3):173-4.
35. Dove JT, Brush JE, Chazal RA, Oetgen WJ. Medical Professional Liability and Health Care System Reform. *J Am Coll Cardiol*. 2010;55(25):2801-3.
36. Katz ED. Defensive Medicine: A Case and Review of Its Status and Possible Solutions. *Clin Pract Cases Emerg*. 2019;3(4):329-32.
37. Kessler DP. Evaluating the Medical Malpractice System and Options for Reform. *J Econ Perspect*. 2011;25(2):93-110.
38. Oliveira T, Neves J, Novais P. Guideline Formalization and Knowledge Representation for Clinical Decision Support. *Adv Distrib Comput Artif Intell J*. 2012;1(2):1-11.
39. Panella M, Rinaldi C, Leigheb F, Knesse S, Donnarumma C, Kul S, et al. Prevalence and costs of defensive medicine: a national survey of Italian physicians. *J Health Serv Res Policy*. 2017;22(4):211-7.
40. Tokar A, Shvarts S, Perry ZH, Doron Y, Reuveni H. Clinical guidelines, defensive medicine, and the physician between the two. *Am J Otolaryngol*. 2004;25(4):245-50.
41. Agarwal R, Gupta A, Gupta S. The impact of tort reform on defensive medicine, quality of care, and physician supply: A systematic review. *Health Serv Res*. 2019;54(4):851-9.
42. Antoci A, Maccioni AF, Russu P. The Ecology of Defensive Medicine and Malpractice Litigation. *Plos One*. 2016;11(3).
43. Avraham R, Dafny LS, Schanzenbach MM. The Impact of Tort Reform on Employer-Sponsored Health Insurance Premiums. *J L Econ & Org*. 2012;28(4):657-86.
44. Bean JR. Defensive medicine: rational response to irrational risk. *World Neurosurg*. 2016;94:568-9.
45. Bourne T, Vanderhaegen J, Vranken R, Wynants L, De Cock B, Peters M, et al. Doctors' experiences and their perception of the most stressful aspects of complaints processes in the UK: an analysis of qualitative survey data. *BMJ Open*. 2016;6(7).
46. Currie J, Macleod WB. First do no harm? Tort reform and birth outcomes. *Quarterly Journal of Economics*. 2008;123(2):795-830.
47. Frakes M. Defensive Medicine and Obstetric Practices. *J Empir Leg Stud*. 2012;9(3):457-81.
48. Frakes M, Gruber J. Defensive Medicine and Obstetric Practices: Evidence from the Military Health System. *J Empir Leg Stud*. 2020;17(1):4-37.
49. Fronczak SW. Defensive medicine: a tax/surcharge for the delivery of healthcare. *World Neurosurg*. 2016;95:594-6.
50. Hermer LD, Brody H. Defensive medicine, cost containment, and reform. *J Gen Intern Med*. 2010;25(5):470-3.
51. Li SH, Dor A, Deyo D, Hughes DR. The Impact of State Tort Reforms on Imaging Utilization. *J Am Coll Radiol*. 2017;14(2):149-56.
52. Moghtaderi A, Farmer S, Black B. Damage Caps and Defensive Medicine: Reexamination with Patient-Level Data. *J Empir Leg Stud*. 2019;16(1):26-68.
53. Paik M, Black B, Hyman DA. Damage caps and defensive medicine, revisited. *J Health Econ*. 2017;51:84-97.
54. Reschovsky JD, Saiontz-Martinez CB. Malpractice Claim Fears and the Costs of Treating Medicare Patients: A New Approach to Estimating the Costs of Defensive Medicine. *Health Serv Res*. 2018;53(3):1498-516.
55. Sataloff J. The first step toward stopping the malpractice insurance crisis. *Ear Nose Throat J*. 2008;87(9):492-4.

56. Segal JJ. Why Doctors Scan Patients Until They Glow. *World Neurosurg.* 2016;90:644-5.
57. Solomon RC. Ethical issues in medical malpractice. *Emerg Med Clin N Am.* 2006;24(3):733.
58. Al-Balas QAE, Al-Balas HAE. The ethics of practicing defensive medicine in Jordan: a diagnostic study. *BMC Med Ethics* 2021;22(1).
59. Calikoglu EO, Aras A. 'Defensive medicine among different surgical disciplines: A descriptive cross-sectional study. *J Forensic Leg Med.* 2020;73:101970.
60. Catino M, Celotti S. The problem of defensive medicine: two Italian surveys. *Stud Health Technol Inform.* 2009;148:206-21.
61. Donner-Banzhoff N, Muller B, Beyer M, Haasenritter J, Seifart C. Thresholds, rules and defensive strategies: how physicians learn from their prior diagnosis-related experiences. *Diagnosis.* 2020;7(2):115-21.
62. Kherad O, Peiffer-Smadja N, Karlafti L, Lember M, Van Aerde N, Gunnarsson O, et al. The challenge of implementing Less is More medicine: A European perspective. *Eur J Intern Med.* 2020;76:1-7.
63. Montagnana M, Lippi G. The risks of defensive (emergency) medicine. The laboratory perspective. *Emerg Care J.* 2016;12(1):17-9.
64. Moosazadeh M, Movahednia M, Movahednia N, Amiresmaili M, Aghaei I. Determining the frequency of defensive medicine among general practitioners in Southeast Iran. *Int J Health Policy Manag.* 2014;2(3):119-23.
65. Prabhu VC. Defensive Medicine in Neurosurgery. *World Neurosurg.* 2016;95:587-9.
66. Renkema E, Ahaus K, Broekhuis M, Tims M. Triggers of defensive medical behaviours: a cross-sectional study among physicians in the Netherlands. *BMJ open.* 2019;9(6):e025108.
67. Simianu VV, Grounds MA, Joslyn SL, LeClerc JE, Ehlers AP, Agrawal N, et al. Understanding clinical and non-clinical decisions under uncertainty: a scenario-based survey. *BMC Med Inform Decis Mak.* 2016;16.
68. Wang D, Zhang X, Askren A, Leslie P. Complexity of Clinical Decision Making: Consent, Capacity, and Ethics. *Int J Environ Res Public Health.* 2019;40(3):162-9.
69. Bae JM. Strategies for Appropriate Patient-centered Care to Decrease the Nationwide Cost of Cancers in Korea. *J Prev Med Public Health.* 2017;50(4):217-27.
70. Bell SK, Mejilla R, Anselmo M, Darer JD, Elmore JG, Leveille S, et al. When doctors share visit notes with patients: a study of patient and doctor perceptions of documentation errors, safety opportunities and the patient-doctor relationship. *BMJ Qual Saf.* 2017;26(4):262-70.
71. Qiao TT, Fan YC, Geater AF, Chongsuvivatwong V, McNeil EB. Factors associated with the doctor-patient relationship: doctor and patient perspectives in hospital outpatient clinics of Inner Mongolia Autonomous Region, China. *Patient Prefer Adherence.* 2019;13:1125-43.
72. Boissy A, Windover AK, Bokar D, Karafá M, Neuendorf K, Frankel RM, et al. Communication skills training for physicians improves patient satisfaction. *J Gen Intern Med.* 2016;31:755-61.
73. Tofan G, Bodolica V, Spraggon M. Governance mechanisms in the physician-patient relationship: a literature review and conceptual framework. *Health Expect.* 2013;16(1):14-31.
74. Náfrádi L, Nakamoto K, Schulz PJ. Is patient empowerment the key to promote adherence? A systematic review of the relationship between self-efficacy, health locus of control and medication adherence. *PloS one.* 2017;12(10):e0186458.
75. Graham B. Clinical practice guidelines: what are they and how should they be disseminated? *Hand Clin.* 2014;30(3):361-5.
76. Hosseini SM, Kimiaimehr F, Alimohammadzadeh K, Bahadori M, Maher A. The study of factors affecting the implementation of clinical guidelines in Iran. *J Mil Med.* 2022;21(3):300-10.
77. Ajami S, Arab-Chadegani R. Barriers to implement electronic health records (EHRs). *Mater Sociomed.* 2013;25(3):213.
78. Bal BS. An introduction to medical malpractice in the United States. *Clin Orthop Relat Res.* 2009;467:339-47.
79. Keane MP, McCormick B, Poplawski G. Health care spending in the US vs UK: The roles of medical education costs, malpractice risk and defensive medicine. *Eur Econ Rev.* 2020;124.
80. Young B, Fogarty AW, Skelly R, Shaw D, Sturrock N, Norwood M, et al. Hospital doctors' attitudes to brief educational messages that aim to modify diagnostic test requests: a qualitative study. *BMC Med Inform Decis Mak.* 2020;20(1).
81. Ries NM, Johnston B, Jansen J. Views of healthcare consumer representatives on defensive practice: 'We are your biggest advocate and supporter horizontal ellipsis not the enemy'. *Health Expect.* 2022;25(1):374-83.
82. Pausch M, Schedlbauer A, Weiss M, Kuehlein T, Hueber S. Is it really always only the others who are to blame? GP's view on medical overuse. A questionnaire study. *Plos One.* 2020;15(1).

Appendix 1. Table S1. Characteristics of included articles

No	Author (Year)	Country	Article type	Publication source	Quality appraisal score
1	Daneshkohan et al. (2023)	Iran	Original	Hospital Practice	STROBE= 20
2	Ries et al. (2022)	Australia	Original	BMC Medical Ethics	CASP= 24
3	Vento et al. (2018)	Kazakhstan	Review	World Journal of Clinical Cases	CASP= 20
4	Moosazadeh et al. (2014)	Iran	Original	International Journal of Health Policy and Management	STROBE= 20
5	Vafae Najar et al. (2016)	Iran	Original	Journal of Healthcare Management	STROBE= 18
6	Ries & Jansen (2022)	Australia	Review	Health Policy	CASP= 24
7	Zerbo et al. (2020)	Italy	Review	Risk Management and Healthcare Policy	CASP= 22
8	Antoci et al. (2022)	Italy	Review	Socio-Economic Planning Sciences	CASP= 20
9	Cervellin & Cavazza (2016)	Italy	Review	Emergency Care Journal	CASP= 22
10	Tuers (2013)	USA	Review	Nursing administration quarterly	CASP= 20
11	Panella et al. (2016)	Italy	Original	Revista de Calidad Asistencial	CASP= 18
12	Pellino & Pellino (2015)	Italy	Review	Updates in Surgery	CASP= 22
13	Kucuk (2018)	Turkey	Original	Journal of Obstetrics and Gynaecology	CASP= 20
14	Reis et al. (2018)	Australia	Review	Journal of Medical Radiation Sciences	CASP= 22
15	Chawla & Gunderman (2008)	USA	Review	Academic Radiology	CASP= 20
16	Oliveira et al. (2012)	Portugal	Review	Advances in Distributed Computing and Artificial Intelligence Journal	CASP= 20
17	Austad et al. (2016)	Norway	Original	BMC Family Practice	CASP= 24
18	Toker et al. (2004)	Israel	Original	American Journal of Otolaryngology	STROBE= 22
19	Katz (2019)	USA	Review	Clinical Practice and cases in emergency medicine	CASP= 22
20	Panella et al. (2017)	Italy	Original	Journal Health Services Research & Policy	STROBE= 20
21	Kessler (2011)	USA	Review	Journal of Economic Perspectives	CASP= 20
22	Blume et al. (2017)	Netherlands	Original	Journal of Evaluation in Clinical Practice	CASP= 18
23	Dove et al. (2010)	USA	Review	Journal of the American College of Cardiology	CASP= 22
24	Carrier et al. (2013)	USA	Original	Health Affairs	CASP= 22
25	Segal (2016)	USA	Review	World Neurosurgery	CASP= 22
26	Reschovsky & Saiontz-Martinez (2018)	USA	Original	Health services research	STROBE= 20
27	Antoci et al. (2016)	Italy	Review	Plos One	CASP= 22
28	Bourne et al. (2016)	UK	Original	BMJ Open	CASP= 22
29	Frakes & Gruber (2020)	UK	Review	Journal of Empirical Legal Studies	CASP= 22
30	Hermer & Brody (2010)	USA	Review	Journal of General Internal Medicine	CASP= 23
31	Moghtaderi et al. (2019)	USA	Original	Journal of Empirical Legal Studies	CASP= 21
32	Agarwal et al. (2019)	USA	Review	Health Services Research	CASP= 22
33	Avraham et al. (2012)	USA	Review	Journal of Law Economics & Organization	CASP= 22
34	Li et al. (2017)	USA	Original	Journal of the American College of Radiology	STROBE= 18
35	Solomon (2006)	USA	Original	Emergency Medicine Clinics of North America,	CASP= 20
36	Currie & MacLeod (2008)	USA	Original	Quarterly Journal of Economics	CASP= 22
37	Fronczak (2016)	USA	Review	World Neurosurgery	CASP= 22
38	Paik et al. (2017)	USA	Review	Journal of health economics	CASP= 21
39	Frakes (2012)	USA	Review	Journal of Empirical Legal Studies	CASP= 20
40	Sataloff (2008)	USA	Review	Ear, Nose & Throat Journal	CASP= 22
41	Bean (2016)	USA	Review	World Neurosurgery	CASP= 22
42	Kherad et al. (2020)	Switzerland	Review	European Journal of Internal Medicine	CASP= 22
43	Calikoglu & Aras (2020)	Turkey	Original	Journal of Forensic and Legal Medicine	STROBE= 20
44	Montagnan & Lippi (2016)	Italy	Review	Emergency Care Journal	CASP= 22
45	Renkema at al. (2019)	Netherlands	Original	BMJ Open	STROBE= 20

Appendix 1. Table S1. Characteristics of included articles

No	Author (Year)	Country	Article type	Publication source	Quality appraisal score
46	Simianu et al. (2016)	USA	Original	BMC Medical Informatics and Decision-Making	STROBE= 20
47	Donner-Banzhoff et al. (2020)	Germany	Original	Diagnosis	CASP= 22
48	Catino & Celotti (2009)	Italy	Original	Studies in health technology and informatics	CASP= 20
49	Askren & Leslie (2019)	USA	Review	Seminars in speech and language	CASP= 19
50	Prabhu (2016)	USA	Review	World Neurosurgery	CASP= 22
51	Al-Balas & Al-Balas (2021)	Jordan	Review	BMC Medical Ethics	CASP= 23
52	Bae (2017)	South Korea	Review	Journal of preventive medicine and public health	CASP= 21
53	Bell et al. (2017)	USA	Original	BMJ quality & safety	STROBE= 20
54	Qiao et al. (2019)	China	Original	Patient preference and adherence	STROBE= 20
55	Boissy et al. (2016)	USA	Original	Journal of General Internal Medicine	STROBE= 20
56	Godillot et al. (2021)	France	Review	Dermatologic therapy	CASP= 20
57	Tofan et al. (2013)	Moldova	Review	Health expectations	CASP= 21
58	Nafradi et al. (2017)	Switzerland	Review	PLoS One	CASP= 24

Appendix 2. Search Strategy

WOS= 1278

#1 (TS=(defensive medicine)) OR TS=(defensive practice)

#2 (((((((TS=(solution\*)) OR TS=(intervention\*)) OR TS=(polic\*)) OR TS=(strateg\*)) OR TS=(suggestion\*)) OR TS=(recommendation\*)) OR TS=(guidelin\*)) OR TS=(approach\*)) OR

TS=(law)) OR TS=(legislat\*)

#3: #1 AND #2

PubMed= 235

((defensive medicine [Title/Abstract]) OR (defensive practice [Title/Abstract] AND (english[Filter]))) AND (((((((solution\*[Title/Abstract]) OR (intervention\*[Title/Abstract])) OR (polic\*[Title/Abstract])) OR (strateg\*[Title/Abstract])) OR (suggestion\*[Title/Abstract])) OR (recommendation\*[Title/Abstract])) OR (guidelin\*[Title/Abstract])) OR (approach\*[Title/Abstract])) OR (law[Title/Abstract])) OR (legislat\*[Title/Abstract] AND (english[Filter]))

Filters: English

ProQuest= 112

(ab(defensive medicine) OR ab(defensive practice)) AND (ab(solution\*) OR ab(intervention\*) OR ab(polic\*) OR ab(strateg\*) OR ab(suggestion\*) OR ab(recommendation\*) OR ab(guidelin\*) OR ab(approach\*) OR ab(law) OR ab(legislat\*))

SCOPUS= 149

#1 ( TITLE ( defensive AND medicine ) OR TITLE ( defensive AND practice ) )

#2 ( TITLE-ABS-KEY ( solution\* ) OR TITLE-ABS-KEY ( intervention\* ) OR TITLE-ABS-KEY ( polic\* ) OR TITLE-ABS-KEY ( strateg\* ) OR TITLE-ABS-KEY ( suggestion\* ) OR TITLE-ABS-KEY ( recommendation\* ) OR TITLE-ABS-KEY ( guidelin\* ) OR TITLE-ABS-KEY ( approach\* ) OR TITLE-ABS-KEY ( law ) OR TITLE-ABS-KEY ( legislat\* ) )

#3 ( LIMIT-TO ( LANGUAGE, "English" ) )

#4: #1 AND #2 AND #3