



Understanding physician prescription behaviors: a systematic review and meta-analysis of macro, meso, and micro-level influences

Giaele Moretti ^a, Francesca Ferrè ^{b,*}, Alma Martelli ^c, Paola Cantarelli ^d

^a Management and Healthcare Lab, Sant'Anna School of Advanced Studies Pisa, Piazza Martiri della Libertà, 33 56127 Pisa, Italy

^b Department of Biomedical Sciences for Health, University of Milan, Via Mangiagalli, 31, 20133 Milano, Italy

^c Department of Pharmacy, University of Pisa, Via Bonanno, 6 56126 Pisa, Italy

^d Institute of Management & Management and Healthcare Lab, Sant'Anna School of Advanced Studies, Pisa, Piazza Martiri della Libertà 33 56127 Pisa, Italy

ARTICLE INFO

Keywords:

Prescription behavior
Physician
Meta-analysis
Strong structuration theory
Policy interventions

ABSTRACT

Background: Prescription is a complex act that reflects the physician's expertise and authority. While some factors affecting prescription decisions have been studied, empirical findings often conflict, leaving our understanding of prescription behaviors limited and fragmented.

Objective: To assess the factors influencing physicians' drug prescribing habits by applying Strong Structuration Theory. Factors are categorized at: physician, practice, patient, industry, and system level.

Methods: Pubmed, Scopus, and ISI Web of Science were searched from inception to June 2025. Peer-reviewed studies were included if they were published in English, empirical, and assessed at least one factor influencing physicians' prescribing behaviors. Studies reporting the effect of covariates on prescriptions using Odds Ratios were included in the meta-analysis.

Results: 146 studies were selected for the review. At the macro-level, physicians were more likely to prescribe after being exposed to marketing activities by pharmaceutical industries, and for privately insured patients. Meso-level factors, such as practice ownership and setting, showed conflicting results, with no significant effect observed in the meta-analysis. Micro-level influences were the most prevalent in literature. Patient requests had a significant positive effect on prescriptions. Physician-level influences were inconsistent across most variables, except gender, where male physicians were more likely to prescribe. This effect was not confirmed by the meta-analysis, which showed heterogeneity across studies.

Conclusion: This study highlights the complexity of prescribing behaviors and the challenges in designing effective micro-level policies. Policymakers should therefore consider the multiple influences on prescribing to design targeted interventions that promote high-quality prescribing practices.

Research in context

1) What is already known about the topic?

The factors influencing prescription practices have been widely explored in the literature.

Factors analyzed in published studies include physicians' characteristics such as gender and age, other factors such as workload, peer influences, and professional norms. Additionally, studies have also focused on patient-physician relationships and pharmaceutical marketing strategies.

(2) What does this study add to the literature?

This study contributes to the literature in two different ways. First, it synthesizes the copious literature on the factors influencing prescription behaviors into macro, meso, and micro levels. Secondly, the study tries to translate its findings into practical recommendations, identifying the key factors that policymakers should consider when formulating policies for physicians.

(3) What are the policy implications?

The review synthesizes macro, meso, and micro-level influences of physician behaviors. First, policymakers must move beyond one-size-fits-all approaches and design multifaceted, context-specific

* Corresponding author at: Department of Biomedical Sciences for Health, University of Milano, Via Mangiagalli, 31, 20133 Milano, Italy.

E-mail addresses: giaele.moretti@santannapisa.it (G. Moretti), francesca.ferre@unimi.it (F. Ferrè), alma.martelli@unipi.it (A. Martelli), paola.cantarelli@santannapisa.it (P. Cantarelli).

<https://doi.org/10.1016/j.healthpol.2025.105415>

Received 5 February 2025; Received in revised form 7 July 2025; Accepted 2 August 2025

Available online 5 August 2025

0168-8510/© 2025 The Author(s). Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

interventions considering also the interplay between the multi-layer influences. Additionally, interventions should be tailored to local contexts, whether by focusing on specific physician groups (e.g., primary care physicians) or medication types (e.g., antibiotics versus antiretrovirals). Lastly, policies should always be monitored and evaluated to ensure long-term effectiveness and to allow for adjustments over time if needed.

1. Background

1.1. Defining prescription

In recent years, drug consumption has increased uniformly across all countries. This rise is attributed to an aging population, the chronic nature of many once-untreatable diseases, and the introduction of increasingly innovative drugs [1]. Consequently, the sustainability of the healthcare systems is now challenged also by higher drug expenditures. Traditionally, physicians serve as key gatekeepers to access medicines, and numerous policies aimed at curbing and optimizing prescribing practices have been introduced at the physician level. However, pharmaceutical prescribing extends beyond merely writing a prescription; it is a complex social and symbolic act that reflects the physician's care and acknowledgment of patient concerns [2,3]. Writing a prescription symbolizes the physician's attempt to address patient needs tangibly [4], and the transition from patient consultation to practical treatment. Furthermore, prescribing is essential to the physician's role, perceived as a critical response not only to patient needs but also to the inherent uncertainties surrounding diagnosis and treatment options [2]. This dual role underscores the complexity of prescribing, as it functions both as a medical decision and a communication strategy for managing patient expectations and clinical uncertainties. The factors influencing prescription practices have been largely explored in the literature. A complex interplay of individual, organizational, and institutional factors shape the decision-making process behind prescriptions. Among these, physician characteristics such as gender and age have received considerable attention, although with conflicting results [5–9]. Other factors, such as workflow pressures and time constraints, may also affect prescribing and the thoroughness with which treatment options are considered [10]. Additionally, patient expectations and pressures have been shown to influence physician practices at both hospital [11] and primary care levels [12,13]. Over the past years, physician prescription practices have gained increased attention within the academic community, with a growing number of articles published on the topic, ranging from qualitative to quantitative studies. While qualitative studies are informative, they may not fully capture the relative importance of various factors influencing prescribing decisions. Quantitative studies, employing a variety of data sources and methodologies – including retrospective record studies, questionnaires, and experimental designs – offer more structured insights. However, there remains a need to systematize the evidence, as existing quantitative studies often present conflicting results and frequently fail to address all the factors that may influence prescribers' decisions.

1.2. Strong structuration theory

We use Strong Structuration Theory (SST) as proposed by Stones [14] to understand the interplay of factors influencing physicians' decision-making processes regarding drug prescription. Stone's SST builds on Giddens' Structuration Theory (ST) [15] to explore its empirical application. SST is primarily used to explore the relationship between individuals (agents) and social structures and is particularly relevant to understanding how people's actions (agency) and the broader social systems (structure) interact in a dynamic and mutually influencing way. The key development in SST is the introduction of the ontology *in situ*, rather than the ontology *in general* of ST [16]. This

serves as an intermediary analytical layer, bridging the gap between high-level theoretical constructs and concrete empirical observations, to understand how individuals and structures interact. SST introduces a more detailed understanding of how structures (e.g., social, economic, political, organizational) enable and constrain human action, suggesting that people, as agents, are not only influenced by these structures but also contribute to shaping and reshaping them through their actions. The key idea in SST is that structures are simultaneously enabling and constraining in a dynamic, recursive relationship with agents. SST incorporates different levels of analysis to examine the influences of structures on individual behavior. Indeed, this framework allows researchers to examine interactions across macro (large-scale societal structures), *meso* (organizational structures), and micro (individual actions) levels within networks, focusing on the dynamic interplay between agency (human action) and structure.

Structures are defined as the rules and resources that shape social systems and are reproduced through recurrent social practices. Stones proposes a quadripartite framework of structure, which consists of external structures as conditions of action, internal structures (how and what individuals know), active agency (where agents draw on their internal structures), and outcomes (in which external and internal structures are reproduced or altered) [14,16,17].

External structures constitute both acknowledged and unacknowledged conditions of action, such as social and professional norms, mores, laws, policies, and standards. These conditions may either enable or constrain the agent's action. External structures are subsequently internalized by individuals as knowledge, experience, morals, and patterns of behavior, becoming internal structures. Internal structures are divided into "conjecturally specific internal structures" (gained over time) and "general-disposition structures" (something that the agent draws on without thinking).

In the healthcare field, Stone's work has been influential in two distinct ways. One stream focuses on analyzing transformations in health systems and healthcare delivery, particularly examining the integration of technology [18–20] and policy changes [21]. The other, though younger and not yet fully developed, explores how individuals' social practices inform decision-making processes [22–24]. The latter includes an examination of how healthcare practices are influenced by both the organizational and individual physicians' actions. With a focus on physicians, SST conceptualized the role of external structures (i.e., macro-level factors and meso-level factors) and their interplay with the internal subjective experiences, which enable or constrain physicians' actions. In the context of the healthcare system, the macro-level refers to social systems (e.g., institutions), the micro-level refers to individuals (e.g., physicians) [25], and the meso-level refers to "the institutions and establishments that individuals interact with on a regular basis" [26]. External structures influence physicians at both the macro level (i.e., system or industry influences) and the meso-level (i.e., practice characteristics). Internal structures at the micro level are divided into conjecturally specific structures, which can be represented by patient-physician interactions, and general-dispositional structures, which include physician-level characteristics such as gender, age, experience, and workload.

This work aims to identify the factors influencing physicians' prescribing behaviors across the macro, *meso*, and micro levels, exploring how the structures at each level shape these behaviors.

2. Method

2.1. Search strategy and selection criteria

The review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [27]. We systematically searched Pubmed, Scopus, and ISI Web of Science from inception to June 2025. The search terms were slightly modified for each database and included (prescri* W/1 behavio*) OR (prescri*

W/1 pattern*) OR (prescri* W/1 practice*) OR (prescri* W/1 decisio*) AND (health*) AND ("practitioner*" OR "physician*" OR "doctor*" OR "specialist" OR "professional" OR "clinician"). The full string, adapted for different databases, is reported in Supporting Information 1 Table 1.

After removing duplicates, two authors (GM and FF) independently screened 9,336 articles. Studies were included for title and abstract screening according to the following criteria:

- The study must be in English and published in peer-reviewed journals.
- The study must be empirical and assess at least one factor affecting the prescription of physicians.

Studies reporting the effect of covariates on prescriptions using Odds Ratios (ORs) were included in a meta-analysis. The results of these studies were aggregated and analyzed according to the following specified categories: physician, practice, industry, system, and patient influences. The search process is summarized in the PRISMA flowchart reported in Supporting Information 1 Fig. 1.

2.2. Data extraction and quality appraisal

Data extraction was performed by a single reviewer (GM) using a standardized checklist in Microsoft Excel, following agreement on the data items to be extracted with the other co-authors. The information extracted included, but was not limited to, the following details: author, year of publication, country of study, study subjects, drugs of interest, study design, outcome(s) of interest and their definitions, variables assessed, and whether an effect on prescription was observed. For studies where an effect was detected, the direction of the effect was also recorded. The quality and completeness of the extracted data were supervised by an additional author (FF).

After data extraction, the quality of the included studies was appraised using the Joanna Briggs Institute instrument [28] with one author (GM) leading the assessment to ensure consistency and another author (FF) contributing to resolve any uncertainties through discussion. The results of the appraisal is reported in Supporting Information 1 Table 1. Importantly, the quality assessment was not used to exclude studies; rather, it served to identify and report heterogeneity in study quality, including aspects of study design, methodology, and reporting.

2.3. Statistical analysis

Studies reporting ORs as measures of association were included in the meta-analysis. ORs were used as the measure of effect size. We used STATA 17 to run the meta-analysis between prescription and selected covariates. Due to the heterogeneity of variables such as age and specialty, it was not possible to include all covariates in the analysis. We included the following variables: gender, practice setting (urban/rural), practice ownership (private/public) and practice type (group/solo). Of the 148 articles included in the review, 38 were eligible for the meta-analysis. Studies were summarized using tables and forest plots to

illustrate study-specific and overall effect sizes. Studies were also checked for heterogeneity using the I^2 statistical test, with 75 %, 50 %, and 25 % referring to high, moderate, and low heterogeneity respectively [29]. Due to significant heterogeneity detected, a meta-analysis using a random effects model was conducted to estimate the pooled effect size with a 95 % confidence interval (CI). In the random effects model each study is assigned a weight that is reciprocal of its variance, including both within-study variance and the estimated between-study variance. Overall, pooled ORs represent the overall association between prescription and selected covariates, reporting individual effects for all covariates included in the analysis. τ^2 is computed to quantify the between-study variance, reflecting the extent of heterogeneity across the studies. Publication bias was assessed both visually, using a funnel plot, and statistically, using Egger's test [30]. Subgroup analysis was performed when at least ten studies in a meta-analysis were available for each variable modeled [31]. Subgroups were the following: practice location, practice structure, practice ownership, and physician gender.

3. Results

3.1. Description of the articles

A total of 146 articles were included in the review. Supporting information 2, Table 1 reports the details of all included studies and the reference list of articles included. In this section, we first describe the characteristics of the included studies, followed by an analysis of the emerging characteristics from the literature. We then categorize the influences on physicians into the following levels: industry (macro-level); system (macro-level); practice (meso-level); patient (micro-level); and physician (micro-level).

Table 1 summarizes the factors identified for the different continents. Of all studies included, 8 were published before the 2000s, 31 (21 %) were published between 2001 and 2010, 56 were published between 2011 and 2020 (38 %), and 53 (36 %) from 2021 onward. The majority of the studies were set in North America (38 %), followed by Europe (28 %) and Asia (23 %). The drugs analyzed in each study were categorized according to the ATC classification, where the active substances are divided into different groups depending on the organ or system on which they act and their therapeutic, pharmacological, and chemical properties [32]. When studies did not focus on a specific drug but included all prescription drugs, we classified them as "No specific drugs". The most represented class was antimicrobial drugs with 41 studies (28 %), followed by nervous system drugs with 35 (24 %), while 33 (23 %) studies did not focus on a specific type of drug. Differences were present in drugs analyzed across different continents. Antimicrobials were the primary focus of articles in Europe. Nervous system drugs were the second-analyzed drug in Europe and the most analyzed in North American studies, especially focusing on opioids. Regarding the type of outcome investigated, most of the papers focused on prescription (83 %), whereas others focused on appropriate prescription (10 %), high prescription (5 %), and inappropriate prescription (2 %). Of all macro-level factors, industry-related factors were the most analyzed

Table 1

Summary characteristics of included studies. *For the factors identified, studies can be categorized into more than one factor depending on the different influences analyzed. Therefore, the total number of studies exceeds the number of studies included in the review (148).

Factor	Europe	Oceania	Asia	North America	South America	Africa	More than one continent	Total
Micro								118
Physician related factors	31	5	22	37	3	4	1	103
Patient-related factors	5	1	3	4	–	1	1	15
Meso								57
Practice related factors	23	3	10	20	–	–	1	57
Macro								32
Industry related factors	1	–	8	10	–	–	–	19
System related factors	2	–	2	7	–	–	–	11
Total	62	9	45	78	3	5	3	*205

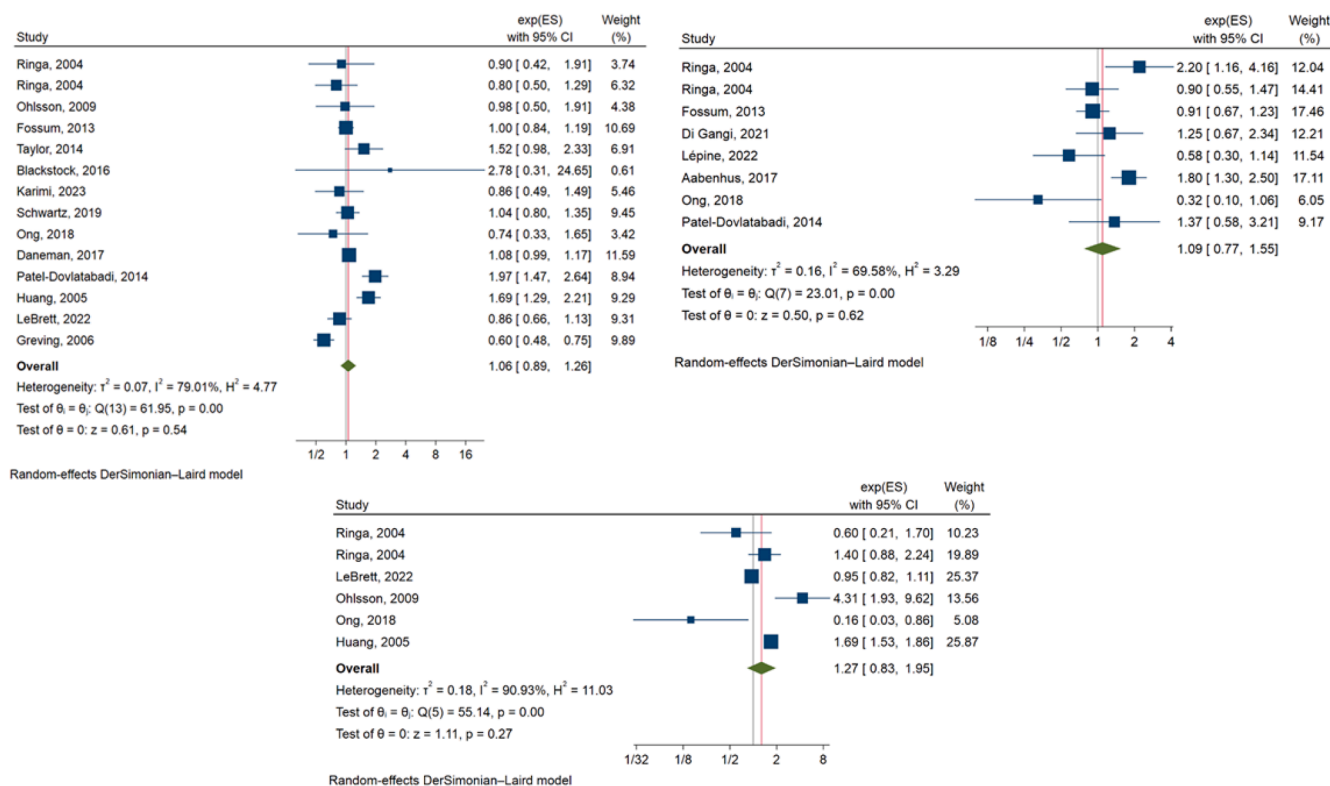


Fig. 1. Forest plot illustrating the pooled effect sizes for practice location on prescriptions (top left), practice structure (top right), and practice ownership (bottom) along with the corresponding confidence intervals and weights assigned to individual studies.

through the studies selected with 19 papers, followed by system-related factors with 11 studies. Meso-level factors, such as practice-level influences, were analyzed in 57 articles. At the micro-level, the most analyzed characteristics were at the physician level with 103 studies, whereas patient-related factors were analyzed in 15 studies. To facilitate reading, all physicians working in primary care (including village doctors, primary care physicians, and general practitioners) were grouped under the term Primary Care Physicians (PCPs), while those with a specialization were categorized as specialists. If the study did not distinguish between PCPs and specialists, they were collectively referred to as "physicians". Of the included studies, 44 % focused on PCPs, 41 % on physicians and 15 % on specialists.

3.2. Macro

3.2.1. Industry-related factors

Industry-related factors were examined in 19 out of the 148 studies included in the review. All marketing activities conducted by pharmaceutical companies targeting physicians were categorized as "marketing activities". This category includes sales representative visits to doctor's office, as well as other promotional activities such as gifts, free attendance at conferences, and paid trips. In 17 of the 19 studies, a correlation was found between such activities and prescribing practices, with physicians being more likely to prescribe after being exposed to marketing.

3.2.1.1. System-related factors. System-related factors were analyzed in 11 studies, which tested the correlation between the type of insurance and prescription practices. Physicians were found to be more likely to prescribe to patients with private insurance in 36.4 % of the studies.

3.3. Meso

3.3.1. Practice related factors

Practice-related factors were examined in 57 of the 148 selected

articles. The most frequently recurring factors included practice setting (rural versus urban), practice structure (*solo* versus group), practice type (e.g., academic or teaching), and practice ownership (public versus private). Practice setting was investigated in 24 studies (42 %) and found to be associated with prescription practices in 12 (50 %). In these 12 studies, physicians in urban or metropolitan areas were more likely to prescribe, with 50 % showing this association. Fewer studies ($n = 4$) found that physicians in rural practices were more likely to prescribe.

Physicians in *solo* practices were more likely to prescribe, as indicated by 5 articles reporting increased prescription rates. Findings for group practices were mixed, with one study indicating a higher likelihood of high prescribing and another suggesting a higher likelihood of inappropriate prescriptions. Eight of the ten studies examining practice ownership found an association with prescribing. Four of these studies reported that physicians in private practices were more likely to prescribe than those in public practices, though this trend was inconsistent. Three studies found that physicians in private practice were less likely to prescribe. Table 2

We conducted the meta-analysis for practice settings using rural as the reference group, for practice structure using *solo* as the reference group, and for practice ownership using public as a reference. The results indicated that no significant effect was detected for any of the three factors. Forest plots for practice location, practice structure, and practice ownership are provided in Fig. 1.

The individual results from the meta-analyses are as follows: (a) the practice location analysis showed no statistically significant association, with a pooled OR of 1.06 across the 14 studies. Substantial heterogeneity was indicated by an I^2 value of 79.01 % confirmed by a τ^2 value of 0.70; (b) the practice structure analysis reported a pooled OR of 1.09, revealing no significant difference between group and *solo* practices, with moderate heterogeneity ($I^2 = 69.58 \%$, $\tau^2 = 0.16$); and (c) the practice ownership analysis suggested a higher likelihood of prescribing in private practices (OR 1.27), although this was not statistically significant (95 % CI: 0.83 to 1.95). High heterogeneity was observed, with

Table 2

Variables identified from the practice-related factors. The second column shows the number of studies that reported a statistically significant correlation, with the total number of studies analyzing the variable of interest shown in parentheses.

Factor	N. of studies with significant correlation* (Total included studies)	Studies reported effect
Practice Setting	10 (22)	Physicians in rural practices were more likely to prescribe ($n = 4$), to prescribe appropriately ($n = 1$), or be high prescribers ($n = 1$). Physicians in urban ($n = 4$) or metropolitan ($n = 2$) practices were more likely to prescribe
Solo/Group Practice	8 (15)	Physicians in solo practices were more likely to prescribe ($n = 5$). Physicians in group practices were less likely to prescribe appropriately ($n = 1$), prescribe ($n = 1$) or be high prescribers ($n = 1$)
Practice Type	7 (15)	Physicians in academic practices were more likely to be high prescribers ($n = 1$) or to prescribe ($n = 1$). Physicians in Hospital practices were more likely to prescribe ($n = 3$). Physicians in training practices were more likely to prescribe ($n = 1$)
Public/Private Practice	8 (10)	Physicians in private practices were more likely to prescribe ($n = 4$) or to be high prescribers ($n = 1$) or less likely to prescribe ($n = 3$)
Practice Region	9 (15)	Not reported due to the large number of different countries.
Practice Size	4 (8)	Physicians in bigger practices were more likely to prescribe ($n = 1$). Physicians in smaller practices were more likely to prescribe ($n = 2$) or prescribe inappropriately ($n = 1$)
Workload	4 (6)	Physicians in practices with higher workloads were more likely to prescribe ($n = 4$)
Deprivation Index	3 (4)	Physicians in practices located in deprived areas were less likely to prescribe ($n = 1$) or more likely to prescribe ($n = 2$)
Percentage of phone consultations	2 (2)	Physicians with low percentage of prescriptions over the phone were more likely to be high prescribers. Physicians in practices with high percentage of phone consultations were more likely to prescribe ($n = 1$)
Income	1 (2)	Physicians in practices located in lower-income places were less likely to prescribe ($n = 1$)
N. consultations/patient	0 (1)	
Number of FTE GPs	1 (1)	Physicians in practices with more FTE GPs were more likely to prescribe ($n = 1$)
Operation days per week	0 (1)	
Gender	1 (1)	All-female practices were less likely to be high prescribers ($n = 1$)
Practice Specialty	1 (1)	
Practice revenue sources	0 (1)	

an I^2 value of 89.97 %. Publication bias was also assessed and found to be high across all variables, as shown in Supporting information1 Fig. 2.

3.3.2. Patient-related factors

Patient-related factors were investigated in 15 articles. The majority of studies found that physicians were more likely to prescribe when patients requested medication. Four studies suggested that physicians were more likely to prescribe when they perceived patients expected a prescription. In contrast, one study reported that physicians were more likely to prescribe when patients did not request a prescription. Table 3 summarizes the findings related to patient-related factors.

Physician-related factors were examined in 103 studies. Among the identified variables, gender was the most frequently analyzed, followed by age, specialty, work experience, and workload. Table 4 summarizes the findings of the studies on these variables.

For gender, 43 % of studies reported a significant association, with conflicting results. In 55 % of the studies reporting an effect, male physicians were found to be more likely to prescribe, while 10 % of studies indicated that male physicians were more likely to be high prescribers, and 3 % reported they were more likely to prescribe inappropriately. Another 10 % of studies found that male physicians were less likely to prescribe inappropriately instead. The gender variable was also assessed in relation to the type of physician. Of 69 studies, 23 (33 %) included both specialists and PCPs, 38 (55 %) focused on PCPs, and only 8 (12 %) examined specialists. Four studies reported an effect for the specialist group, while the remaining four showed no effect. For PCPs, the results were similarly balanced, with 55 % of studies reporting an effect of gender on prescribing and 45 % finding no association.

Age was analyzed in 52 % of the included studies, with 28 (52 %) reporting some form of significant association, either positive or negative. The study results exhibited significant variation in the thresholds used to define the age groups under analysis, making comparisons challenging.

Regarding prescriber specialty, an association was found in 79 % of the studies that included this variable. PCPs were found to be more likely to prescribe compared to specialists in 47 % of included studies, and less likely in the remaining 23 %. Additionally, PCPs were found to be more likely to prescribe appropriately in 10 % of the studies. In 63 % of studies, work experience was found to be a significant factor influencing prescription behaviors, but the overall findings for this variable remain fragmented. A larger portion of studies (23 %) indicated that more experienced physicians were more likely to prescribe, while others reported the opposite (14 %). Additionally, when considering physicians with less than two years of experience as less experienced, the percentage rises to 18 %. Other factors, such as workload, education, and role, also demonstrated varying degrees of influence on prescribing behaviors. For instance, physicians with a higher patient workload were more likely to prescribe ($n = 5$), while those with advanced education were more likely to prescribe appropriately ($n = 2$).

Gender was also analyzed through meta-analysis using males as the reference group, with the results presented in Fig. 2. The meta-analysis revealed significant variability across studies, with some reporting strong effects while others showed no significant association. Although individual studies reported associations, the overall pooled effect size was close to 1.0, indicating no significant relationship between gender and prescription when all data were combined. The high heterogeneity ($I^2 = 90.18$ %) suggested substantial inconsistency between studies, possibly due to differences in study design, populations, methodologies, or the drug under investigation. Overall, the results are inconclusive. Publication bias was assessed using a funnel plot and Egger's test, both of which revealed a high prevalence of bias, as shown in Supporting Information 1 Figure 3. Subgroup analysis for medication drug type was also performed. There was no significant difference for antimicrobial drugs (OR 1.069; 95 % C.I 0.98 to 1.16) although with moderate heterogeneity ($I^2=57.51$, $\tau^2 = 0.01$). No significant differences were observed in the prescribing of cardiovascular or antineoplastic drugs.

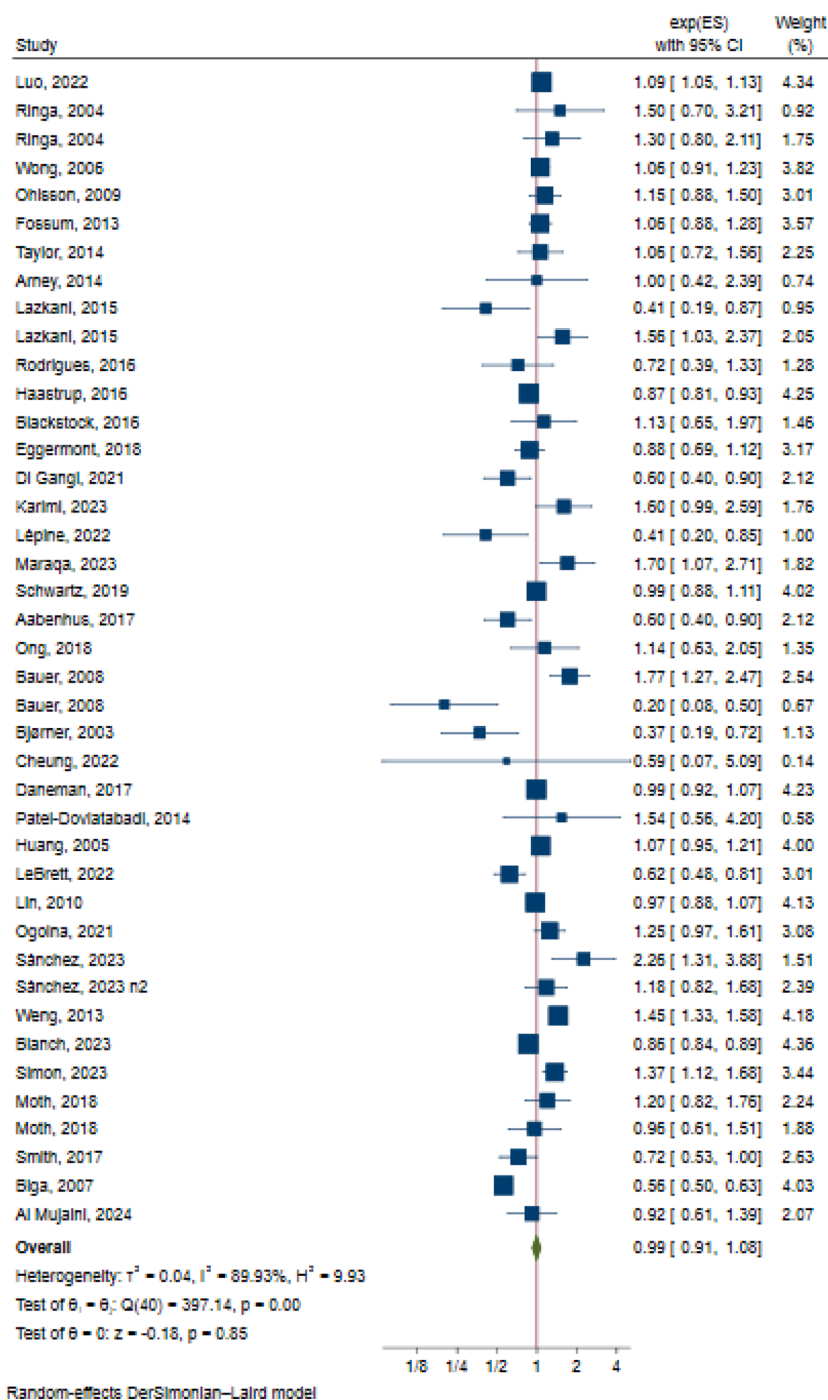


Fig. 2. Forest plot illustrating the pooled effect sizes for gender on prescriptions, along with the corresponding confidence intervals and weights assigned to individual studies.

Women were 9 % more likely to prescribe hormonal therapies than men (95 % CI: 1.048–1.128; $I^2 = 0.00$; $\tau^2 = 0.00$), although this estimate was based on only four studies. In contrast, women were 31 % less likely to prescribe nervous system drugs compared to men (95 % CI: 0.508–0.943), with substantial heterogeneity across studies ($I^2 = 86.18$; $\tau^2 = 0.158$).

4. Discussion

This review used the SST theoretical framework to identify and examine factors that influence agents (physicians) prescribing behaviors across the three levels: macro, meso, and micro. It also examined how

those behaviors are shaped (or not) by the structures at each level.

We identify external structures to be categorized into macro-level influences, which include system and industry-related factors, and meso-level influences, which encompass practice-related factors. Micro-level influences were identified in patient and physician-related factors. Retrieved literature on external structures at the macro-level is less extensive compared to that at the meso-level. At the system level, the most frequent variable was the type of insurance held by patients. The findings are mixed, with only half of the studies reporting a significant increase in prescriptions for patients with private insurance. Notably, half of such studies were based in the United States (US), where the influence of private insurance markets is well-documented [33]. In the

Table 3

Variables identified from the patient related factors. The second column shows the number of studies that reported a statistically significant correlation, with the total number of studies analyzing the variable of interest shown in parentheses. Physician related factors.

Factor	N. of studies with significant correlation* (Total included studies)	Studies reported effect
Patient expectation	4 (8)	Physicians were more likely to prescribe when patients expected a prescription ($n = 4$)
Patient request	6 (6)	Physicians were more likely to prescribe when patients requested a prescription ($n = 4$) Physicians were more likely to prescribe inappropriately when patients didn't request a prescription ($n = 1$) Physicians were more likely to prescribe when patients didn't request a prescription ($n = 1$)
Legal expectation	1 (1)	Physicians were more likely to prescribe when patients legally expected a prescription ($n = 1$)
Patient pressure	0 (2)	

US healthcare system, insurance plans often dictate the treatments covered, and physicians may adjust their practices accordingly. Additionally, private insurance may cover a broader range of medications, which could explain the observed differences in prescription patterns [34]. Industry-related influences are well-established in the literature, with a positive association between marketing activities and prescription behaviors, as extensively discussed in previous works [35]. The predominantly public nature of some European healthcare systems and the presence of highly regulated commercial codes of conduct regulating interactions between companies and healthcare professionals may influence prescription patterns differently, offering a contrast to the private U.S. system and partly explaining the observed heterogeneity between the two contexts.

Meso-level factors were addressed in 39 % of the articles, reflecting a growing interest in this level, although not yet developed as fully as the micro-level. Practice setting, structure, and ownership emerged as the most frequently investigated aspects, but overall, a lack of consensus was observed in the literature. These findings were confirmed by the meta-analysis, which revealed no overall effect and highlighted the heterogeneity between studies. Only practice ownership emerged as a potential factor influencing prescribing behavior, even though not statistically significant. Although not significant, physicians employed in private practices were found to be 27 % more likely to prescribe in the meta-analysis, which may be explained by the fact that privately employed physicians may not be as influenced by the organizational culture and may feel less committed to, or identify less with, the formal positions of their institutions [36]. Current literature on meso-level factors remains incomplete, as numerous other variables—such as organizational culture, administrative support, team dynamics, and peer-to-peer interactions—remain relatively underexplored.

Shifting the focus to the internal structures influencing the agent, we examined micro-level factors specific to both the physician and the patient. In our work, we argue that prescribing is a multifactorial act that extends beyond the purely medical act; it is deeply embedded in the social role of the physician. The prescription serves as a means of acknowledgment that the patient's concerns are recognized and addressed. Thus, the act of prescribing reinforces the trust and relationship between the patient and the physician [2,3]. As discussed in previous work [20], structures not only exert pressure on the agency, but micro-level interactions between patients and physicians also directly impact the agent. We observe a significant association between patient influences and prescribing practices, alongside an overall lack of consensus regarding physician-related factors. Despite the growing body of evidence on physician-related influences, the findings remain inconclusive, even for some of the most frequently analyzed factors. We find that male physicians are generally more likely to prescribe, but the results regarding prescription appropriateness are conflicting. The increased prescribing among male physicians may be attributed to differences in practice styles, as female physicians are reported to adopt a more patient-centered approach, characterized by longer consultations and greater adherence to clinical guidelines [37,38]. No consensus was reached regarding the influence of age and experience on prescribing

behaviors, with some studies indicating that older and more experienced physicians are more likely to prescribe. This could be linked to increased confidence in patient management and enhanced self-efficacy as physicians age and gain experience [39]. On the other hand, some studies found that younger physicians are more likely to prescribe. Previous research suggests that younger, and therefore less experienced, physicians are associated with improved quality of care and are more likely to adhere to established treatment standards [40]. Results regarding specialty revealed greater consistency across studies, with PCPs being more likely to prescribe.

SST provided a comprehensive, multi-level framework that facilitates an extensive examination of the interplay between structure and agency. With its layered approach encompassing the macro, meso, and micro levels, this framework illustrates the recursive relationship between the physicians and the structures that surround them. Physicians, as agents, are not passive; their practices are both shaped by and contribute to the structures in which they operate. Systemic influences, such as healthcare policies and decisions or industry-related activities, impact physicians' behaviors in the process to make them subject to evolving practices. Similarly, interactions with patients at the micro-level directly influence practices, while agents themselves play an active role in reinforcing or altering these structures. SST is a comprehensive framework that helps explain the complexity of prescribing, showing how physicians operate within a variety of interconnected elements at different levels and can be usefully applied to other healthcare issues such implementation of e-health technologies or public health programs (e.g., vaccination, antibiotic stewardship programs). This complexity also reflects the challenges of translating good practice into real-life applications. Indeed, the assumption of the intercorrelation between agency and structure presents challenges in identifying a clear causal relationship with the agent's practices. Consequently, policy-makers may struggle to prioritize where interventions are most needed and effective, potentially becoming overwhelmed by the need to account for all structural influences. Interventions designed to address specific issues may have unintended consequences or be effective only in specific contexts. Context refers to country-specific factors such as the governance model, healthcare financing system, and reimbursement mechanisms, and also to broader systems-level elements like social and cultural norms and values. In our review, 39 % of the included studies were based in North America, with the majority in the US, where the healthcare system is market-driven, primarily private, and characterized by a significant role for private insurance providers alongside government programs. The remaining 28 % of studies were conducted in Europe, where healthcare systems vary but are generally characterized by publicly funded models with universal coverage, such as the National Health Service (NHS) in the UK or the single-payer system in countries like France and Sweden, where the government plays a central role. Other macro-level factors that directly target micro-level agents, such as physician remuneration systems, must be considered. Fee-for-service models are more common in systems dominated by private insurance and incentivize physicians to increase the volume of services provided, which can lead to overprescribing or the selection of more expensive

Table 4

Variables identified from the physician-related factors. The second column shows the number of studies that reported a statistically significant correlation, with the total number of studies analyzing the variable of interest shown in parentheses.

Factor	N. of studies with significant correlation* (Total included studies)	Studies reported effect
Gender	31 (71)	Male physicians were more likely to prescribe ($n = 18$), be high prescribers ($n = 3$) or prescribe inappropriately ($n = 1$), or prescribe appropriately ($n = 3$) Female physicians were more likely to prescribe ($n = 3$) Female physicians were more likely to prescribe renin-angiotensin drugs but less likely to prescribe antibiotics ($n = 1$) Male physicians were more likely to prescribe anti neuropathic pain drugs but less likely to prescribe SySADDA ($n = 1$) Female physicians were more likely to prescribe Methylodopa but less likely to prescribe Beta blockers and Diuretics ($n = 1$)
Age	28 (54)	Older physicians were more likely to prescribe ($n = 4$) or prescribe inappropriately ($n = 2$) or to be high prescribers ($n = 1$) Younger physicians were more likely to prescribe ($n = 3$) or prescribe appropriately ($n = 1$) Physicians younger than 45 years old were less likely to prescribe ($n = 3$) Age was not significant for the prescription of all pain medications, but older physicians were less likely to prescribe opioids ($n = 1$) Older physicians were less likely to prescribe SSRI but more likely to prescribe combination therapy ($n = 1$) Physicians older than 32 were less likely to prescribe inappropriately ($n = 1$) Physicians older than 36 were more likely to prescribe ($n = 1$) Physicians aged 50 to 65 years old were more likely to be high prescribers ($n = 1$) Physicians younger than 40 were more likely to prescribe ($n = 1$) Physicians between 31 and 40 years were more likely to prescribe ($n = 1$) Physicians between 40 and 59 were more likely to prescribe ($n = 1$) Physicians older than 40 ($n = 2$) and older than 50 ($n = 1$) were more likely to prescribe Physicians aged 35–44 were less likely to prescribe ($n = 1$) Physicians older than 55 were less likely to prescribe ($n = 1$) Physicians older than 55 years old were more likely to prescribe ($n = 1$)
Specialty	30 (38)	Primary Care Physicians were more likely to prescribe ($n = 14$) or prescribe appropriately ($n = 3$) Primary Care Physicians were less likely to prescribe ($n = 7$) Specialists were more likely to prescribe appropriately ($n = 1$) The number of prescriptions varies depending on the specialty ($n = 1$)

Table 4 (continued)

Factor	N. of studies with significant correlation* (Total included studies)	Studies reported effect
Work Experience	22 (35)	Pediatricians were less likely to prescribe than dermatologists ($n = 1$) Pediatricians were more likely to prescribe ($n = 1$) Primary Care Physicians, internal medicine, and cardiovascular disease physicians were more likely to prescribe ($n = 1$) Internists prescriber a lower number of drugs per prescription than pediatricians ($n = 1$) Physicians with more experience were more likely to prescribe ($n = 5$), or prescribe inappropriately ($n = 4$) Physicians with more experience were not significantly associated with prescription of any pain medication but were more likely to prescribe paracetamol ($n = 1$) Physicians with more experience were less likely to prescribe ($n = 3$) or prescribe appropriately ($n = 1$) Physicians with >3 years of experience were less likely to prescribe ($n = 1$) or prescribe appropriately ($n = 1$) Physicians with >5 years of experience were more likely to prescribe ($n = 1$) or less likely to prescribe ($n = 1$) Physicians with >20 years of experience were less likely to prescribe ($n = 1$) Physicians with at least 25 years of experience were more likely to prescribe ($n = 1$) Physicians with 35–24 years of experience were less likely to prescribe inappropriately than physicians with >35 years of experience ($n = 1$) Physicians with >40 years of experience were more likely to prescribe inappropriately ($n = 1$) Physicians with a heavier workload were more likely to prescribe ($n = 5$) or be high prescribers ($n = 1$) Physicians with a lower workload were more likely to prescribe ($n = 2$) or be high prescribers ($n = 1$), prescribe inappropriately ($n = 1$), or to prescribe appropriately ($n = 1$) Physicians with an intermediate workload were more likely to prescribe appropriately ($n = 1$) Physicians seeing >60 patients per day reported being more influenced to prescribe ($n = 1$) Physicians with >20 patients a day were more likely to be high prescribers ($n = 1$)
Workload	14(20)	Physicians with higher education were less likely to prescribe ($n = 2$) Physicians with a postgraduate certificate were more likely to prescribe appropriately ($n = 2$) or to prescribe ($n = 3$) Family medicine physicians were less likely to prescribe inappropriately than general practice and internal medicine ($n = 1$) GP Specialists were less likely to prescribe($n = 1$)
Education	9 (14)	

(continued on next page)

Table 4 (continued)

Factor	N. of studies with significant correlation* (Total included studies)	Studies reported effect
Place of Graduation	4 (8)	Foreign physicians were more likely to prescribe ($n = 2$) or to be high prescribers ($n = 1$) Foreign physicians were less likely to prescribe ($n = 1$)
Role	6 (9)	Attending and resident physicians were more likely to prescribe ($n = 2$) or prescribe inappropriately ($n = 1$) Clinical officers were more likely to prescribe appropriately ($n = 1$) Consultants and medical officers/residents were more likely to prescribe appropriately than house officers ($n = 1$) Junior residents were more likely to prescribe ($n = 1$)
Education on drugs	2 (5)	Physicians with previous experience with IMD were more likely to prescribe ($n = 1$) Physicians who attended educational courses on antibiotics were more likely to prescribe appropriately ($n = 1$)
Physician Type	3 (4)	Office-based physicians were more likely to prescribe than hospital-based physicians ($n = 1$) Academic physicians were less likely to prescribe ($n = 1$) and more likely to prescribe appropriately ($n = 1$)
Full Time Equivalent	2 (3)	Physicians with longer working hours were more likely to prescribe ($n = 1$) Physicians working part-time were more likely to prescribe ($n = 1$)

treatments [41]. In publicly funded healthcare systems, physicians' remuneration is usually structured around fixed salaries, capitation for PCPs, or performance-related incentives. Capitation incentivizes enrolling and retaining more patients, potentially leading to more cautious prescribing to avoid unnecessary treatments [42]. Fixed salary remuneration offers no direct financial incentives for specific behaviors, so physicians may prioritize quality care within standard operating hours [43]. However, the introduction of various financial incentive schemes has made it difficult to ascertain their effects on changes in healthcare professionals' behaviors, though some evidence suggests they may help reduce prescribing costs [44].

The analysis of context-specific factors also allowed us to understand the different distributions of drugs studied across countries. In the American context, the focus on nervous system drugs, especially opioids, is driven by the opioid crisis that continues to affect the U.S. healthcare system. In contrast, the European focus is more on antimicrobial drugs, particularly antibiotics, reflecting the increasing burden of antimicrobial resistance and the importance of effective measures to limit prescription and raise awareness [45].

However, the lack of significant results in the meta-analysis represents another noteworthy result and raises questions about the quality of the studies. We found high levels of heterogeneity, driven by the variety of methodologies and study designs, and different contexts. Heterogeneity could derive from the inclusion of studies conducted in different countries with varying methodologies and, likely, differing levels of scientific rigor. Additionally, different outcomes were used (e.g., prescription on appropriate prescription), further complicating the possibility to apply meta-analytic techniques. The between-countries differences, both in terms of national health systems and governance mechanisms, might have influenced the results. Another contributing factor could be the difference in data sources, as prescribing behavior data is difficult to obtain and comes from different sources. Some studies

relied on administrative databases, whereas others used electronic health records or questionnaires, with prescription data assessed based on self-reported frequency or likelihood of prescribing. This suggests that, despite the growing interest in the topic, methodological inconsistencies exist. Consequently, it remains challenging to estimate a definitive overall effect of macro, *meso* and micro-level forces on prescribing practices.

This review presents some limitations that should be addressed. First, the search strategy included only articles published in English; the exclusion of non-English papers is generally considered to have minimal impact, as reported by other scholars in the medical field [46,47]. Second, this review may be biased by excluding studies that did not report quantitative data. Qualitative studies, which can provide rich insights into human behavior [48], particularly about social and professional influences, as well as individual attitudes and feelings, were not included. Third, while factors influencing prescribing were assessed, the potential outcomes of these prescriptions on patients or the healthcare system were not examined. Different prescribing choices can lead to varying outcomes depending on both patient characteristics and the type of medication prescribed. For example, it is important to account for patient morbidity and mortality data to assess differences in patient health status that may influence physician prescribing patterns. Also, certain categories of medications, such as opioids and antibiotics, can have a greater impact on public health thus requiring special attention and consideration. Therefore, although our analysis focused on the prescribing decision itself, we believe that future research should also consider the outcomes of these prescribing actions.

Building on the insights generated by this review, future investigations should give greater prominence to *meso*-level determinants of prescribing behavior—an area still markedly underrepresented in the literature. In particular, organizational and practice-based characteristics warrant systematic examination, along with the dynamic interactions that link macro-, *meso*- and micro-level influences, which are too often analyzed in isolation. Longitudinal designs are needed to trace the medium- and long-term effects of policy interventions, while cross-national comparative studies can help disentangle contextual differences in prescribing patterns that are not artefacts of study design. Measurement quality also requires attention: reliance on self-reported data should be reduced by triangulating findings with administrative or electronic health-record sources to curb reporting bias. Finally, mixed-methods approaches—especially those that blend quantitative and qualitative techniques or apply quasi-experimental designs—are essential for capturing nuanced drivers of prescribing, such as ethical norms, levels of trust, confidence in clinical guidelines, and value alignment among stakeholders, all of which remain difficult to quantify but critical to understanding prescribing behavior in real-world settings.

5. Conclusions and implications

Prescribing behaviors is confirmed to be a complex task influenced by the interplay between macro, *meso*, and micro-level factors. How physicians make prescribing decisions will depend, at least to some extent, on institutional conditions, practice characteristics, and individual dispositions. However, as revealed by this meta-analysis, it is still unclear the direction and effect played by these forces.

The findings underline the challenges that policymakers face in formulating effective policies targeting physician prescribing. In recent decades, policymakers have become increasingly interested in reforms explicitly designed to improve appropriate prescribing to reduce costs and improve quality. To name a few the introduction of economic incentives such as budget-holding and pay-for-performance [44], education-based interventions to increase prescribing competencies [49], prescribing guidelines and prescription feedback [50], and more. However, interventions designed to improve prescribing should account for this interplay and be multifaceted, adapting to the local context to enable practical application by physicians in their environment and be

tailored to specific physician groups (e.g., PCPs) or medication types (e.g., antibiotics). Different drugs may require different policies depending on factors such as disease prevalence and their availability to specific subsets of patients or vulnerable groups. For example, policies for regulating antibiotics will differ from those for anti-retroviral drugs used in HIV treatment. Additionally, the synthesis of literature underscores the value of designing and implementing policy interventions that address the various levels of influence (macro, meso, and micro). Moreover, policymakers should not only focus on policy implementation but also prioritize ongoing monitoring and evaluation after implementation [51]. Long-term and robust monitoring and assessment systems are crucial for identifying areas that may require adjustments and ensuring that interventions continue to align with their objectives over time.

It is clear that a one-size-fits-all policy cannot effectively address the variability of prescribing among physicians. Policymakers should leverage the multifaceted influences shaping prescribing practices to develop new policy schemes and targeted interventions that promote high-quality prescribing. These interventions should account for both macro- and meso-level influences, as well as micro-on-micro pressures (i.e., patient-physician interactions). Furthermore, this comprehensive review offers physicians an opportunity to reflect on the various factors influencing their decision-making processes and, in turn, impacting patient health. This can foster greater self-awareness and encourage more thoughtful, evidence-based prescribing.

Funding

This work was supported by the Italian Ministry of University and Research (MUR), project “HEALTH TECH: Technologies for More Resilient and Sustainable Social-Health Systems” under the Fund for the Promotion and Development of Policies within the National Research Program (PNR), in accordance with EU Regulation No 241/2021 and the PNRR 2021–2026.

CRedit authorship contribution statement

Giaele Moretti: Writing – original draft, Visualization, Formal analysis, Data curation, Conceptualization. **Francesca Ferrè:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization. **Alma Martelli:** Writing – review & editing, Validation. **Paola Cantarelli:** Writing – review & editing, Validation, Methodology.

Declaration of Interest statement

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Giaele Moretti reports financial support provided by Italian Ministry of University and Research. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.healthpol.2025.105415](https://doi.org/10.1016/j.healthpol.2025.105415).

References

- [1] OECD. Health At A Glance 2023: Oecd Indicators. Health at a Glance. OECD; 2023. <https://doi.org/10.1787/7a7afb35-en>.
- [2] Geest SVD, Whyte SR, Hardon E A. THE Anthropology of pharmaceuticals: a biographical approach. *Annu Rev Anthr* 1996;25(1):153–78. <https://doi.org/10.1146/annurev.anthro.25.1.153>. fasc.
- [3] Pellegrino ED. Prescribing and drug ingestion symbols and substances. *Drug Intell Clin Pharm* 1976;10(11):624–30. <https://doi.org/10.1177/106002807601001101.fasc>.
- [4] Gabe E S, Lipshitz-Phillips J, necessity? Evil. The meaning of benzodiazepine use for women patients from one general practice. *Sociol Health Illn* 1982;4(2):201–9. <https://doi.org/10.1111/1467-9566.ep11339945>. fasc.
- [5] Liu C, Liu C, Wang D, Zhang X. Intrinsic and external determinants of antibiotic prescribing: a multi-level path analysis of primary care prescriptions in Hubei, China. *Antimicrob Resist Infect Control* 2019;8(1):132. <https://doi.org/10.1186/s13756-019-0592-5>. fasc.
- [6] Gerber JS, et al. Variation in antibiotic prescribing across a pediatric primary care network. *J Pediatr Infect Dis Soc* 2015;4(4):297–304. <https://doi.org/10.1093/jpids/piu086>. fasc.
- [7] Kern WV, de With K, Nink K, Steib-Bauert M, Schröder e H. Regional variation in outpatient antibiotic prescribing in Germany. *Infection* 2006;34(5):269–73. <https://doi.org/10.1007/s15010-006-6618-y>. fasc.
- [8] Jung S, Sexton ME, Owens S, Spell N, Fridkin e S. Variability of antibiotic prescribing in a large healthcare network despite adjusting for patient-mix: reconsidering targets for improved prescribing. *Open Forum Infect Dis* 2019;6. <https://doi.org/10.1093/ofid/ofz018>. fasc. 2, p. ofz018.
- [9] Mishra A, Read SH, Rochon e PA. Influence of physician sex and gender on prescribing practices among older adults. *J Am Geriatr Soc* 2020;68(12):2764–7. <https://doi.org/10.1111/jgs.16851>. fasc.
- [10] Leviatan I, Oberman B, Zimlichman E, Stein e GY. Associations of physicians' prescribing experience, work hours, and workload with prescription errors. *J Am Med Inf Assoc* 2021;28(6):1074–80. <https://doi.org/10.1093/jamia/ocaa219>. fasc.
- [11] Wang SY, Cantarelli P, Groene O, Stargardt T, Belle e N. Patient expectations do matter - experimental evidence on antibiotic prescribing decisions among hospital-based physicians. *Health Policy* 2023;128:11–7. <https://doi.org/10.1016/j.healthpol.2022.11.009>.
- [12] Dempsey PP, Businger AC, Whaley LE, Gagne JJ, Linder e JA. Primary care clinicians perceptions about antibiotic prescribing for acute bronchitis: a qualitative study. *BMC Fam Pr* 2014;15(1):1–10. <https://doi.org/10.1186/S12875-014-0194-5/TABLES/1>. fasc.
- [13] McNulty CA, Nichols T, French DP, Joshi P, Butler e CC. Expectations for consultations and antibiotics for respiratory tract infection in primary care: the RTI clinical iceberg. *Br J Gen Pr* 2013;63(612). <https://doi.org/10.3399/bjgp13X669149>. fasc.e429–e436.
- [14] *Stones R. Structuration Theory*. Bloomsbury Publishing; 2005.
- [15] Giddens A. *The Constitution Of Society : Outline Of The Theory Of Structuration*. Cambridge: Polity Press; 1984 [Cambridgeshire].
- [16] Jack L, Kholeif e A. Introducing strong structuration theory for informing qualitative case studies in organization, management and accounting research. *Qual Res Organ Manag Int J* 2007;2(3):208–25. <https://doi.org/10.1108/17465640710835364>. fasc.
- [17] Bodolica V, Spraggon M, Tofan e G. A structuration framework for bridging the macro–micro divide in health-care governance. *Health Expect* 2016;19(4):790–804. <https://doi.org/10.1111/hex.12375>. fasc.
- [18] Greenhalgh T, Stones e R. Theorising big IT programmes in healthcare: strong structuration theory meets actor-network theory. *Soc Sci Med* 2010;70(9):1285–94. <https://doi.org/10.1016/j.socscimed.2009.12.034>. fasc.
- [19] Greenhalgh T, Stones R, Swinglehurst e D. Choose and book: a sociological analysis of 'resistance' to an expert system. *Soc Sci Med* 2014;104:210–9. <https://doi.org/10.1016/j.socscimed.2013.12.014>.
- [20] Assing Ihvidt E, Grønning A, Nisbeth Brøgger M, Møller JE, Fage-Butler e A. Multilevel structures and human agency in relation to email consultations: a strong structuration theory analysis of the Danish general practice setting. *Soc Sci Med* 2021;282:114155. <https://doi.org/10.1016/j.socscimed.2021.114155>.
- [21] Hughes G, Shaw SE, Greenhalgh e T. Why doesn't integrated care work? Using strong structuration theory to explain the limitations of an English case. *Sociol Health Illn* 2022;44(1):113–29. <https://doi.org/10.1111/1467-9566.13398>. fasc.
- [22] Hinder S, Greenhalgh e T. This does my head in". Ethnographic study of self-management by people with diabetes. *BMC Health V Res* 2012;12(1):83. <https://doi.org/10.1186/1472-6963-12-83>. fasc.
- [23] Hajizadeh A, et al. Clinician resistance to broaching the topic of weight in primary care: digging deeper into weight management using strong structuration theory. *Soc Sci Med* 2023;329:115997. <https://doi.org/10.1016/j.socscimed.2023.115997>.
- [24] Geneau R, Lehoux P, Pineault R, Lamarche e P. Understanding the work of general practitioners: a social science perspective on the context of medical decision making in primary care. *BMC Prim Care* 2008;9(12). <https://doi.org/10.1186/1471-2296-9-12>. fasc.
- [25] Richter e N, Dragano M, Micro macro, meso? but what about. The institutional context of health inequalities. *Int J Public Health* 2018;63(2):163–4. <https://doi.org/10.1007/s00038-017-1064-4>. fasc.
- [26] Kramer MR, et al. Getting under the skin: children's health disparities as embodiment of social class. *Popul Res Policy Rev* 2017;36(5):671–97. <https://doi.org/10.1007/s11113-017-9431-7>. fasc.
- [27] Page MJ, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Syst Rev* 2021;10(1):89. <https://doi.org/10.1186/s13643-021-01626-4>. fasc.
- [28] The Joanna Briggs Institute, *The joanna briggs institute (2014) joanna briggs institute reviewers' manual*. 2014.
- [29] Melsen WG, Bootsma MCJ, Rovers MM, Bonten e MJM. The effects of clinical and statistical heterogeneity on the predictive values of results from meta-analyses.

- Clin Microbiol Infect Off Publ Eur Soc Clin Microbiol Infect Dis 2014;20(2):123–9. <https://doi.org/10.1111/1469-0691.12494>. fasc.
- [30] Sedgwick P, Marston e L. How to read a funnel plot in a meta-analysis. *BMJ* 2015; 351. <https://doi.org/10.1136/bmj.h4718>. h4718.
- [31] Deeks J, Higgins J, Altman e D. Chapter 10: analysing data and undertaking meta-analyses. *Cochrane Handb Syst Rev Interv* version 64 2023. a ed., Cochrane, www.training.cochrane.org/handbook.
- [32] World Health Organization, Anatomical therapeutic chemical (ATC) classification [Online]. <https://www.who.int/tools/atc-ddd-toolkit/atc-classification> [Accessed 2025].
- [33] T. Rice, P. Rosenau, L.Y. Unruh, e A.J. Barnes, Health system in transition: USA, 2020. <https://eurohealthobservatory.who.int/publications/i/united-states-health-system-review-2020>.
- [34] Briesacher BA, Stuart B, Ren X, Doshi JA, Wrobel e MV. Medicare beneficiaries and the impact of gaining prescription drug coverage on inpatient and physician spending. *Health v Res* 2005;40:1279–96. <https://doi.org/10.1111/j.1475-6773.2005.00432.x>. fasc. 5p1.
- [35] Mitchell AP, et al. Are financial payments from the pharmaceutical industry associated with physician prescribing? A systematic review. *Ann Intern Med* 2020; 174(3):353. <https://doi.org/10.7326/M20-5665>. fasc.
- [36] Gross R, Tabenkin H, Brammli-Greenberg e S. Factors affecting primary care physicians' perceptions of health system reform in Israel: professional autonomy versus organizational affiliation. *Soc Sci Med* 2007;64(7):1450–62. <https://doi.org/10.1016/j.socscimed.2006.11.012>. fasc.
- [37] Tsugawa Y, Jena AB, Figueroa JF, Orav EJ, Blumenthal DM, Jha e AK. Comparison of hospital mortality and readmission rates for Medicare patients treated by male vs Female physicians. *JAMA Intern Med* 2017;177(2):206–13. <https://doi.org/10.1001/jamainternmed.2016.7875>. fasc.
- [38] Roter DL, Hall e JA. Physician gender and patient-centered communication: a critical review of empirical research. *Annu Rev Public Health* 2004;25:497–519. <https://doi.org/10.1146/annurev.publhealth.25.101802.123134>.
- [39] Desveaux L, Saragosa M, Kithulegoda N, Ivers e NM. Understanding the behavioural determinants of opioid prescribing among family physicians: a qualitative study. *BMC Fam Pr* 2019;20(1):59. <https://doi.org/10.1186/s12875-019-0947-2>. fasc.
- [40] Choudhry NK, Fletcher RH, Soumerai e SB. Systematic review: the relationship between clinical experience and quality of health care. *Ann Intern Med* 2005;142 (4):260. <https://doi.org/10.7326/0003-4819-142-4-200502150-00008>. fasc.
- [41] Kraft KB, Hoff EH, Nylenna M, Moe CF, Mykletun A, Østby e K. Time is money: general practitioners' reflections on the fee-for-service system. *BMC Health v Res* 2024;24(1):1–10. <https://doi.org/10.1186/S12913-024-10968-3/FIGURES/1>. fasc.
- [42] Jia L, Meng Q, Scott A, Yuan B, Zhang e L. Payment methods for healthcare providers working in outpatient healthcare settings. *Cochrane Database Syst Rev* 2021;2021(1). <https://doi.org/10.1002/14651858.CD011865.pub2>. fascCD011865.
- [43] Gosden T, et al. Capitation, salary, fee-for-service and mixed systems of payment: effects on the behaviour of primary care physicians. *Cochrane Database Syst Rev* 2000;(3). <https://doi.org/10.1002/14651858.CD002215>. fascCD002215, 2000.
- [44] Flodgren G, Eccles MP, Shepperd S, Scott A, Parmelli E, Beyer e FR. An overview of reviews evaluating the effectiveness of financial incentives in changing healthcare professional behaviours and patient outcomes. *Cochrane Database Syst Rev* 2011; 7. <https://doi.org/10.1002/14651858.CD009255>. fasc.
- [45] OECD. Fighting antimicrobial resistance in EU and EEA countries. *Policy Br* 2023. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/11/fighting-antimicrobial-resistance-in-eu-and-eea-countries_aa49a732/fdb1629f-en.pdf.
- [46] Dobrescu A, et al. Restricting evidence syntheses of interventions to English-language publications is a viable methodological shortcut for most medical topics: a systematic review. *J Clin Epidemiol* 2021;137:209–17. <https://doi.org/10.1016/j.jclinepi.2021.04.012>.
- [47] Nussbaumer-Streit B, et al. Excluding non-English publications from evidence-syntheses did not change conclusions: a meta-epidemiological study -. *J Clin Epidemiol* 2020;118:42–54. <https://doi.org/10.1016/j.jclinepi.2019.10.011>.
- [48] Rose J, Crosbie M, Stewart e A. A qualitative literature review exploring the drivers influencing antibiotic over-prescribing by GPs in primary care and recommendations to reduce unnecessary prescribing. *Perspect Public Health* 2021; 141(1):19–27. <https://doi.org/10.1177/1757913919879183>. fasc.
- [49] Kamarudin G, Penm J, Char B, Moles e R. Educational interventions to improve prescribing competency: a systematic review. *BMJ Open* 2013;3(8). <https://doi.org/10.1136/bmjopen-2013-003291>. fasce003291.
- [50] Lagerlov P, Loeb M, Andrew M, Hjortdahl e P. Improving doctors' prescribing behaviour through reflection on guidelines and prescription feedback: a randomised controlled study. *Qual Health Care QHC* 2000;9(3):159–65. <https://doi.org/10.1136/qhc.9.3.159>. fasc.
- [51] Moretti G, Canto BD, Attanasio F, Martelli A, Ferrè e F. Quale efficacia degli strumenti di governance prescrittiva? Risultati dall'applicazione delle note AIFA. *Glob Reg Health Technol Assess* 2024;11:131–7. <https://doi.org/10.33394/grhta.2024.3027>.