

BMJ Open Impact of vitamin D non-reimbursement policy on therapy discontinuation in the general and rheumatic population in the Netherlands: a cross-sectional study

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ABSTRACT

Objective To assess the impact of the non-reimbursement policy on vitamin D therapy discontinuation in patients from the general and rheumatic populations.

Design A cross-sectional study.

Setting Research institute specialised in health research and two outpatient pharmacies in the Netherlands.

Participants Patients from the general and rheumatic population with an active prescription for vitamin D supplementation therapy were included.

Data collection and analysis Data were collected between April and May 2023 through self-reported questionnaires. Descriptive statistics and logistic regression were performed using STATA V. 17. P value <0.05 was considered statistically significant.

Primary and secondary outcome measures The primary outcome was the proportion of patients who discontinued vitamin D supplementation therapy following the implementation of the non-reimbursement policy. Secondary outcomes included patient-reported reasons for therapy discontinuation and the association between patient-related characteristics and the risk of therapy discontinuation. In addition, the proportion of patients who switched to an alternative supplement and whether this switch had been made in consultation with a healthcare provider was examined.

Results Of the 4800 patients, 302 (6.4%) patients discontinued their vitamin D therapy. The three most frequently reported reasons for therapy discontinuation were the inability to afford supplements without reimbursement, not willing to pay for supplements without reimbursement and being unaware of the alternative vitamin D supplements to switch to. Younger age, financial constraints and limited health literacy were significantly associated with vitamin D therapy discontinuation ($p < 0.05$). Among the 1478 patients that switched to an alternative supplement, 706 (17.9%) patients indicated that they made the switch in consultation with a healthcare provider.

Conclusion The implementation of the non-reimbursement policy resulted in a small proportion of patients discontinuing their vitamin D therapy. Elevated discontinuation rates were associated with specific patient-related characteristics including patients aged <50 years, those experiencing financial constraints and

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study provides valuable insights into the real-world impact of the Dutch non-reimbursement policy on vitamin D therapy utilisation in daily practice.
- ⇒ The inclusion of 4800 participants with a medical indication for vitamin D represents a robust sample size for a questionnaire-based study, with a diverse population consisting of general and rheumatic participants.
- ⇒ Reliance on self-reported data introduces the risk of recall bias, as participants may not accurately remember or report their reasons for discontinuation.
- ⇒ Social desirability bias may influence patient responses, potentially leading to an underestimation of vitamin D discontinuation rates.
- ⇒ The utilisation of questionnaires may have excluded certain populations, particularly vulnerable groups who are less likely to participate in questionnaire-based research, which may result in an underestimation of the discontinuation rates.

those with limited health literacy, suggesting the need for developing interventions and preventive strategies to support patients at risk of therapy discontinuation.

INTRODUCTION

Vitamin D is a soluble steroid hormone with an established role in maintaining bone health, regulating calcium and phosphate metabolism and modulating immune responses.^{1,2} Despite the availability of dietary sources and endogenous synthesis through sunlight exposure, vitamin D deficiency remains prevalent across the general population,^{1,3} with prevalence rates of 13.0% in Europe and 15.7% globally.^{4,5} Several risk factors are associated with this condition, including age, sex, ethnicity, seasonality, pregnancy as well as specific medical conditions and pharmacological treatments.⁵⁻⁹ Chronic vitamin D deficiency is linked to a

variety of diseases and can cause deterioration in overall health, development of osteoporosis and an increased risk of fall-related fractures.^{10–15} In addition, it contributes to increased healthcare expenditures due to higher rates of hospitalisations and is recognised as a risk factor for elevated mortality rates.^{16–17} To prevent these adverse outcomes, healthcare guidelines recommend vitamin D supplementation therapies for patients at risk or those with existing deficiencies.^{18–21}

Vitamin D supplementation therapies are widely prescribed in Western countries.^{22–24} In the Netherlands, being the focus of this study, approximately 1 million prescriptions for vitamin D analogues were dispensed annually in the period between 2019 and 2023.²⁵ Furthermore, certain vitamin D supplements are available over-the-counter in drugstores, where they are often purchased based on general health recommendations rather than medical necessity, further contributing to their frequent utilisation.^{3–26} However, on 1 January 2023, a non-reimbursement policy for all vitamin D supplements was implemented in the Netherlands. This policy was based on the assumption that vitamin D supplements were considered affordable for patients and that healthcare expenditures could be reduced by 129 million euros yearly.^{27–28} This decision raised concerns among healthcare and patient organisations, as it was anticipated that this policy would adversely affect patients' therapy persistence with prescribed vitamin D regimens, potentially leading to treatment discontinuation. Moreover, patients with increased vulnerability, including patients with limited health literacy or financial constraints as well as patients for whom continuation of supplementation is clinically essential such as patients with rheumatic conditions, were expected to be disproportionately affected by this policy.^{16–27–28}

Limited health literacy can impair a patient's ability to understand the importance of their therapy,²⁹ potentially leading to reduced adherence or even treatment discontinuation when associated costs are incurred.³⁰ In addition, socioeconomic status plays an essential role in non-reimbursement policies, as patients with financial constraints may prioritise essential living expenses over purchasing supplements that are no longer reimbursed, preventing them from continuing their therapy.¹⁶ In patients with rheumatic conditions, the risk of developing osteoporosis is elevated due to the prolonged use of medications, such as glucocorticoids, which adversely affect bone health.³¹ Given the crucial role of vitamin D in maintaining bone health, continuing vitamin D therapy is clinically relevant for these patients.^{1–2–32} These patients may decide to discontinue their therapy, potentially leading to deterioration of bone health or even increasing their susceptibility to fall-related fractures.^{31–33}

Understanding the impact of the non-reimbursement policy on vitamin D therapy discontinuation is essential, as vitamin D deficiencies can exacerbate existing health conditions. In addition, a comprehensive understanding of patient-related characteristics (eg, limited health

literacy and socioeconomic status) influencing therapy discontinuation is crucial for developing strategies to improve access to vitamin D supplementation. Therefore, the aim of this study is to investigate the effects of the vitamin D non-reimbursement policy on therapy discontinuation in both the general and rheumatic population. In addition, this study will assess the reported reasons for vitamin D discontinuation as well as explore patient-related characteristics that may be associated with vitamin D therapy discontinuation.

METHOD

Study design and setting

This cross-sectional study was conducted at Nivel, the Netherlands Institute for Health Services Research, and two outpatient pharmacies located in the Sint Maartenskliniek (SMK) in Nijmegen and Reade in Amsterdam, the Netherlands. Nivel is an independent research organisation that conducts health services research with one of its focuses on the quality and effectiveness of the Dutch healthcare system.³⁴ The primary focus of SMK is the treatment of movement disorders.³⁵ Reade provides specialised care for rheumatologic and rehabilitation conditions.³⁶ The study was performed in April and May 2023, after introduction of the non-reimbursement policy on 1 January 2023.

Data collection and eligibility criteria

In order to assess the impact of the vitamin D non-reimbursement policy, Nivel focused on the general population using vitamin D supplements prescribed by any physician. The Nivel Dutch Health Care Consumer Panel (DHCCP) and an open link were used to approach patients with an online supplemental questionnaire. SMK and Reade focused on patients with rheumatic diseases using vitamin D supplements as prescribed by their rheumatologists. Eligible patients were approached by email and invited to participate in an online supplemental questionnaire.

The DHCCP is an access panel, comprising a large number of participants who have voluntarily agreed to regularly respond to healthcare-related surveys. On joining the panel by invitation, participants receive detailed information regarding the purpose of the panel, scope, methodology and data usage. Based on the given information, participants can provide informed consent for participation. All data collected is pseudonymised and processed in accordance with the panel's privacy policy. The panel undergoes regular renewal to ensure the continuous selection of representative samples of the Dutch population. Participation is entirely voluntary, and members are not obligated to complete surveys or answer specific questions. For this study, panel members of the DHCCP were contacted via email to participate in the online questionnaire. A more detailed description of the DHCCP can be found in the report by Brabers and De Jong.³⁷ In addition, an open link to the questionnaire was

created to reach a broader population in the Netherlands. This open link was widely disseminated through multiple channels, with the cooperation of individual healthcare providers, various patient organisations, the Royal Dutch Pharmacists Association, and among members of the Labyrinth panel, which is a panel of approximately 2700 members of whom about 60% have a migration background. Participants were required to provide informed consent before proceeding with the questionnaire.

In SMK and Reade, patients were eligible for inclusion if they were ≥ 18 years of age and had been prescribed vitamin D supplements, vitamin D analogues (cholecalciferol or calcifediol) or a combination of vitamin D with calcium or vitamin D with bisphosphonates by a rheumatologist within the period of July 2022 and 15 November 2022. This period was specifically selected to target patients who were already on vitamin D therapy in 2022 and who would probably have consumed their entire supply of supplements before the implementation of the non-reimbursement policy. Eligible patients who had provided consent for contact were approached and informed about the study through an electronic patient information letter. A link was provided within the letter, in which patients could access detailed study information and the questionnaire. If patients opted to participate, they were requested to digitally sign an informed consent form and then proceed to complete the questionnaire.

Participants from both Nivel and SMK and Reade were able to complete the questionnaire in April and May 2023.

Content questionnaire

The questionnaires were provided in Dutch and consisted of three sections. One section comprised sociodemographic and socioeconomic characteristics including sex, age, educational level, financial status and migration background. The second section focused on vitamin D therapy. Participants were asked about their specific vitamin D supplement, dosage and indication for its use. In addition, participants were questioned about their intended actions regarding their therapy after the implementation of the non-reimbursement policy, with several options including therapy discontinuation, continuation with the prescribed supplement by the physician or switching to an alternative supplement. Participants could also indicate that they were uncertain regarding their intended actions. Participants continuing with their current supplement were questioned about their plans once their supply would run out during the implementation of the non-reimbursement policy. Follow-up questions were asked to gain more insight into the reasons for the patients' answers. Participants who opted to continue with an alternative supplement were asked whether the switch was made in consultation with a healthcare provider.

The final section of the questionnaire assessed health literacy using the Dutch HLS-EU-Q16 version.^{38 39}

The questionnaires were designed to ensure comprehensibility, using straightforward language and multiple-choice formats whenever possible. Each section was presented with a brief introduction, and a clear layout was used. To evaluate the content and comprehensibility, a subset of included patients from SMK and Reade pretested the questionnaire. Their feedback was incorporated into the final version prior to distribution. The Nivel questionnaire and the questionnaire used for SMK and Reade patients were largely similar. The questionnaires are provided in online supplemental appendices I and II.

Outcome measures

The primary outcome was the proportion of patients with a prescription for vitamin D who discontinued therapy supplementation following the implementation of the non-reimbursement policy. Secondary outcomes included patient-reported reasons for therapy discontinuation and the association between individual patient characteristics and the risk of therapy discontinuation. In addition, the proportion of patients who switched to an alternative supplement and whether this switch had been made in consultation with a healthcare provider was examined.

Ethical considerations

According to Dutch legislation, approval by a Medical Research Ethics Committee (MREC) is not obligatory for conducted questionnaire-based research using the Nivel DHCCP.³⁷ The Review Committee of the Amsterdam University Medical Center has confirmed that research conducted through the DHCCP is not subject to approval by a medical ethics committee (file number: 2024-1150).

For SMK and Reade, the MREC of the Radboud University Medical Center in Nijmegen waived official ethical approval (file number: 2025-17883) and assessed the cross-sectional study as not being subject to the Medical Research Involving Human Subjects Act (WMO). Patient data were collected and processed in accordance with the principles of the Declaration of Helsinki. Participation in this study was voluntary, with patients having the option to respond to the questions at their discretion.

Statistical analysis

Data analysis was performed using STATA V. 17. All data were pseudonymised. Patient characteristics were presented using mean ($\pm$ SD) or median (p25–p75) values depending on the parametric or non-parametric distribution of the measured variables. Response rates were calculated as the number of completed questionnaires divided by the number of invitations sent, multiplied by 100%. Descriptive statistics were used to assess the proportion of patients discontinuing their vitamin D therapy. The χ^2 test was conducted to compare the proportion of patients discontinuing their vitamin D therapy and the proportion of patients continuing their vitamin D therapy across Nivel, SMK and Reade. Univariate logistic regression analysis was performed to identify potential patient-related characteristics

associated with vitamin D therapy discontinuation. Variables with a p value <0.10 were included in the multivariate logistic regression analysis. Ensuring a minimum of 10 cases per variable determined that the sample size for the multivariate model was sufficient. P value <0.05 was considered statistically significant.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

A total of 4800 patients received a prescription for vitamin D supplementation in 2022, comprising

266 from SMK, 164 from Reade, 673 from the Nivel DHCCP and 3697 from the Open Link. The majority of patients were in the age group of 50–69 years (46.0%), with 20.0% of the total patient population being male and 77.2% having a Dutch background. Most patients had attained a high (28.8%) or middle (44.9%) level of education. Regarding financial status, 47.3% of the patients reported having many or little savings. Furthermore, 57.8% of the patients were classified as having sufficient health literacy.

The demographic and socioeconomic characteristics of the patients from each centre as well as for the entire patient population are presented in [table 1](#).

Table 1 Overview of socioeconomic and sociodemographic patient characteristics

Characteristics	SMK (n=266)	Reade (n=164)	Nivel DHCCP (n=673)	Open Link (n=3697)	Total (n=4800)
Patient characteristics					
Age, n (%)					
<30 years		2 (1.2)	2 (0.3)	86 (2.3)	90 (1.9)
30–49 years	11 (4.1)	14 (8.5)	80 (11.9)	506 (13.7)	611 (12.7)
50–69 years	133 (50.0)	83 (50.6)	178 (26.5)	1813 (49.0)	2207 (46.0)
70–79 years	99 (37.2)	48 (29.3)	235 (34.9)	986 (26.7)	1368 (28.5)
≥80 years	23 (8.7)	16 (9.8)	178 (26.5)	291 (7.9)	508 (10.6)
Missing	–	–	–	15 (0.4)	15 (0.4)
Gender, n (%)					
Male	70 (26.3)	44 (26.8)	277 (41.2)	567 (15.3)	958 (20.0)
Female	196 (73.7)	120 (73.2)	396 (58.8)	3101 (83.9)	3813 (79.4)
Missing	–	–	–	29 (0.8)	29 (0.6)
Level of education, n (%)					
High	76 (28.6)	65 (39.6)	235 (34.9)	1007 (27.2)	1383 (28.8)
Middle	142 (53.4)	74 (45.1)	344 (51.1)	1593 (43.1)	2153 (44.9)
Low	48 (18.0)	25 (15.2)	77 (11.4)	412 (11.1)	562 (11.7)
Missing	–	–	17 (2.6)	685 (18.5)	702 (14.6)
Background, n (%)					
Dutch	256 (96.3)	130 (79.3)	605 (89.9)	2713 (88.7)	3704 (77.2)
Western/non-Western migration	10 (3.7)	34 (20.7)	64 (9.5)	347 (9.3)	455 (9.5)
Missing	–	–	4 (0.6)	637 (17.2)	641 (13.3)
Financial situation, n (%)					
Many/little savings	176 (66.2)	108 (65.8)	406 (60.3)	1579 (42.7)	2269 (47.3)
Making ends meet	68 (25.5)	38 (23.2)	158 (23.5)	1024 (27.7)	1288 (26.8)
Living on savings/in debt	22 (8.3)	18 (11.0)	48 (7.1)	376 (10.2)	464 (9.7)
Missing	–	–	61 (9.1)	718 (19.4)	779 (16.2)
Health literacy level, n (%)					
Likely sufficient (13–16)	196 (73.7)	116 (70.7)	425 (63.2)	2037 (55.1)	2774 (57.8)
Likely insufficient (1–12)	70 (26.3)	48 (29.3)	125 (18.5)	819 (22.2)	1062 (22.1)
Missing	–	–	123 (18.3)	841 (22.7)	964 (20.1)
DHCCP, Nivel Dutch Health Care Consumer Panel; SMK, Sint Maartenskliniek.					

Table 2 Reported reasons for vitamin D therapy discontinuation

Reported reasons for vitamin D discontinuation	SMK (n=23)	Reade (n=14)	Nivel DHCCP* (n=44)	Open Link* (n=221)	Total (n=302)
Not able to afford without reimbursement, n (%)	9 (39.1)	3 (37.5)	6 (13.6)	108 (48.9)	126 (41.7)
Unwilling to pay without reimbursement, n (%)	4 (17.4)	3 (37.5)	15 (34.1)	70 (31.7)	92 (30.5)
Unaware of which alternative to switch to, n (%)	2 (8.7)	–	2 (4.5)	35 (15.8)	39 (12.9)
Intention to purchase supplement, but did not have the opportunity, n (%)	1 (4.3)	1 (12.5)	3 (6.8)	16 (7.2)	21 (7.0)
Usage of multiple medications, n (%)	1 (4.3)	–	2 (4.5)	11 (5.0)	14 (4.6)
Other reasons, n (%)	6 (30.4)	7 (50.0)	21 (47.8)	46 (20.8)	80 (26.5)

*Patients in Nivel Panel and Open Link were allowed to report multiple reasons for vitamin D discontinuation. This was not the case for patients from SMK and Reade who had to choose one answer that fits their situation correctly.

DHCCP, Nivel Dutch Health Care Consumer Panel; SMK, Sint Maartenskliniek.

Response rates were 21.9% for SMK, 21.8% for Reade and 50.8% for Nivel DHCCP. A response rate could not be calculated for the open link group.

Vitamin D discontinuation rates and reasons

Of the 4800 patients, a total of 4688 (97.7%) reported their actions in response to the vitamin D non-reimbursement policy. Of these, 302 (6.4%) patients reported discontinuation of vitamin D therapy. No significant differences in discontinuation rates were observed between SMK, Reade, Nivel DHCCP and Open Link (discontinuation rates of 8.6%, 8.5%, 6.5% and 6.0%, respectively, with $p=0.204$).

The three most frequently reported reasons for vitamin D therapy discontinuation were the inability to afford supplementation without reimbursement, not willing to pay for supplementation without reimbursement and being unaware about which alternative supplementation patients should switch to. Other reasons for therapy discontinuation included doubt regarding the efficacy of vitamin D if not reimbursed, reluctance to switch to another alternative supplementation, a perceived lack of the benefits from vitamin D and the belief that vitamin D was no longer necessary. The reasons for vitamin D therapy discontinuation are summarised in [table 2](#).

Association between patient characteristics and vitamin D discontinuation

Univariate logistic regression analysis revealed that age, migration background, financial status and health literacy tended to be associated with vitamin D therapy discontinuation ($p<0.10$, not shown in table). Multivariate logistic regression analysis revealed that younger age (below 50 years), having financial constraints (categorised as making ends meet, living on savings and in debt) and having limited health literacy were significantly associated with an increased risk of vitamin D therapy discontinuation ($p<0.05$). The complete results of the multivariate logistic regression analysis are presented in [table 3](#).

Vitamin D continuation: type of supplement and consultation with healthcare provider

Of the 4688 patients, a total of 3947 (84.2%) decided to continue their vitamin D therapy. Of these, 1478 (37.4%) patients switched to an alternative vitamin D supplement. The proportion of patients switching to an alternative vitamin D supplement was significantly higher at

Table 3 Multivariate logistic regression of the association between patient characteristics and vitamin D therapy discontinuation (n=3778)

Patient characteristics	OR	95% CI	P value
Age			
<30 years	2.937	1.316 to 6.551	0.009
30–49 years	2.588	1.873 to 3.575	<0.0001
50–69 years	Reference		
70–79 years	0.835	0.582 to 1.199	0.329
≥80 years	0.843	0.489 to 1.451	0.537
Background			
Dutch	Reference		
Western/non-Western migration	1.372	0.959 to 1.962	0.083
Financial status			
Many/little savings	Reference		
Making ends meet	1.843	1.367 to 2.483	<0.0001
Living on savings/in debt	2.492	1.731 to 3.587	<0.0001
Health literacy			
Likely sufficient (13–16)	Reference		
Likely inadequate/limited (1–12)	1.469	1.115 to 1.936	0.006

Table 4 Switching to an alternative vitamin D supplement

Continuation of vitamin D	SMK (n=231)	Reade (n=144)	Nivel DHCCP (n=531)	Open Link (n=3041)	Total (n=3947)
Switched to an alternative vitamin D supplement, n (%)	152 (65.8)	40 (27.8)	167 (31.5)	1119 (36.8)	1478 (37.4)
Switched to an alternative vitamin D supplement in consultation with a healthcare provider, n (%)	98 (42.2)	22 (15.3)	90 (16.9)	496 (16.3)	706 (17.9)

DHCCP, Nivel Dutch Health Care Consumer Panel; SMK, Sint Maartenskliniek.

SMK in comparison to Reade, Nivel DHCCP and Open Link (65.8%, 27.8%, 31.5% and 36.8%, respectively, $p < 0.0001$). Of the 1478 patients that switched to an alternative supplement, 706 (17.9%) patients indicated that they made the switch in consultation with a healthcare provider (table 4).

DISCUSSION

The implementation of the vitamin D non-reimbursement policy resulted in vitamin D therapy discontinuation in 302 patients (6.4%). Key reasons for discontinuation included financial constraints, unwillingness to pay without reimbursement and lack of awareness of alternative supplements. Limited health literacy, financial constraints and younger and middle age were associated with higher discontinuation rates. Notably, patients in the SMK group were more likely to switch to alternative supplements following healthcare provider consultations compared with other groups, suggesting the importance of provider guidance during transitions caused by policy changes.

During the announcement of the non-reimbursement policy, healthcare providers and patient organisations expressed concerns about its impact on discontinuation rates. While a 6.4% discontinuation rate might appear modest, it translates to a considerable number of individuals, especially when considering the 1 million individuals receiving vitamin D prescriptions annually in the period between 2019 and 2023.²⁵ If 6.4% of these patients were to discontinue therapy, it would affect approximately 64 000 individuals annually.

Patient-related characteristics influencing therapy discontinuation should be considered. Limited health literacy may prevent patients from understanding the medical necessity of treatment,⁴⁰ increasing the likelihood of therapy discontinuation when reimbursement is halted. Financial constraints also play a crucial role in the decision-making process, especially when patients face additional healthcare expenses. Although the annual cost of vitamin D (ranging from approximately €7.30 to €25.00 per patient)²⁸ may not seem substantial, individuals with multiple chronic conditions often incur substantial overall healthcare costs, including co-payments for other medications, leading to a cumulative effect on their overall healthcare expenses.¹⁶ As a result, patients are forced to prioritise their spending, with financial

constraints influencing their decision to continue their treatment. Moreover, younger patients (aged <30 and 30–49) may perceive less urgency to continue supplementation, whereas older patients with comorbidities are more likely to adhere to their therapies, influenced by frequent interactions with healthcare providers and adherence to medical recommendations.³⁸

Comparison to other studies

Although several studies have examined the impact of non-reimbursement policies on medication therapy persistence, direct comparisons between these studies remain challenging due to variations in sampling methods, patient populations, healthcare systems, indications and medication classes involved. For instance, Delate *et al*⁴¹ found that prior authorisation (PA) policies led to a 92% discontinuation rate of proton pump inhibitors (PPIs), with patients switching to more affordable H₂ receptor antagonists (H₂RAs). This shift was primarily driven by cost-savings restrictions, with H₂RAs being a more affordable option for patients. Fischer *et al*⁴² observed no significant changes in discontinuation rates for renin-angiotensin antagonists (RAAs), likely due to their essential role in managing conditions like hypertension and heart failure where patients may be less likely to switch medications due to clinical necessity.⁴² Hartun *et al*⁴³ reported a 58.9% discontinuation rate for the non-steroidal anti-inflammatory drug celecoxib following PA policy implementation. Moreover, Brabers *et al*²⁷ demonstrated that non-reimbursement policies for certain vitamins, minerals and paracetamol impacted medication persistence. Despite the decline in continuation rates of these medications, there were no significant increases in the use of alternative healthcare services or costs, suggesting that patients either discontinued their medication therapy or opted for more affordable alternatives.²⁷ Across these studies, a consistent trend emerges indicating that cost-driven policies do tend to adversely impact medication therapy persistence, resulting in increased therapy discontinuation rates.

In addition to the studies discussed above, the review by Green *et al*⁴⁴ further summarised the effects of pharmaceutical policies, particularly restrictions on medication utilisation. It was found that the impact of reimbursement restrictions is not always predictable. In some cases, restrictions may lead to increased utilisation of other medication classes, as was seen in Delate *et al*,⁴¹

thereby preventing suboptimal treatment. However, in other studies, patients simply discontinued their medication therapy due to financial barriers. Furthermore, the effects of policies could be mitigated by factors such as patient education and the active involvement of healthcare providers in providing support for patients. This was demonstrated in our findings, where patients at the SMK centre were actively switched to an alternative vitamin D supplement. However, despite the active involvement of these healthcare providers, the discontinuation rates remained similar, suggesting the need for alternative approaches.

Recommended research

The clinical and economic implications of vitamin D therapy discontinuation following the implementation of the non-reimbursement policy remain uncertain. Although our study identified that 6.4% of patients discontinued their therapy, the impact on their health outcomes and overall well-being has yet to be evaluated. In addition, the data were collected shortly after the policy change, meaning the long-term effects were not assessed in our study. It remains unclear whether vitamin D users will switch to alternative supplements or discontinue their therapy, despite initially reporting an intention to continue with their therapy in the future. For instance, vitamin D users may initially continue using the same supplement after their first purchase but later switch to more affordable alternatives on realising that cheaper supplements are available. This behaviour may also extend to patients who initially opted to discontinue their therapy. Future research should focus on specific patient subgroups, such as vitamin D users with limited health literacy or financial constraints, as our findings suggest that specific patient-related characteristics influence therapy discontinuation. Moreover, qualitative research is warranted to better understand the motivations behind patients' decisions to either continue or discontinue vitamin D therapy, as the reasons reported in our study lacked in-depth exploration. For example, it remains unclear why a minority of patients, despite reporting having financial savings, still chose to discontinue treatment. A more detailed exploration of these reasons could inform future policy adjustments to ensure that patient well-being is adequately considered in the implementation of such policies.

Strengths and limitations

This study offers several strengths. First, it provides valuable insights into the impact of the non-reimbursement policy on vitamin D therapy utilisation. By using structured questionnaires, we were able to gather data on the rates of (dis)continuation of vitamin D therapies and the patient-reported reasons for discontinuation, contributing to the understanding of the real-world implications of medication policy changes. Second, 4800 individuals with a medical need for vitamin D completed the questionnaire, representing a large sample size for a questionnaire-based

study. The patient population was diverse, including individuals from the general population, vulnerable patients at higher risk for discontinuation and those for whom vitamin D therapy is clinically relevant (eg, patients with rheumatic diseases at elevated risk of osteoporosis). This study also has several limitations. First, reliance on self-reported data may introduce recall bias, as patients may not accurately recall their reasons for discontinuing therapy. Second, social desirability bias could also have influenced patient responses, potentially leading to an underestimation of discontinuation rates. Third, the use of questionnaires may have excluded certain populations, particularly vulnerable groups who are less likely to participate in questionnaire-based research, which could result in an underestimation of the discontinuation rates. Lastly, no information was available on individuals who discontinued vitamin D treatment prior to the removal of reimbursement (eg, due to non-adherence or personal factors). Including such data would have allowed for a clearer distinction between discontinuation attributable to the policy change and pre-existing adherence patterns, thereby providing additional context to the findings.

Implications for clinical practice

Individuals with limited health literacy and financial constraints are disproportionately affected by non-reimbursement policies. It is essential that healthcare systems should prioritise these vulnerable populations by implementing preventive measures and targeted support, including financial assistance for individuals unable to afford medication, health education initiatives to improve health literacy and additional support by healthcare providers to mitigate the adverse effects of such policies. Furthermore, while non-reimbursement policies are primarily implemented to reduce healthcare costs, their cost-saving effectiveness may vary depending on the specific medication and patient population.⁴² In some cases, rather than decreasing the overall healthcare burden, these policies might inadvertently lead to increased costs. For instance, the non-reimbursement policy for low-dose vitamin D supplements in 2019 was associated with an increase in prescriptions for more expensive high-dose vitamin D supplements that were eligible for reimbursement.²⁷ Additionally, the impact of these policies on medication discontinuation rates may not be immediately measurable, further complicating the assessment of their long-term effects on patient health and healthcare utilisation.

CONCLUSION

Following the implementation of the non-reimbursement policy, a relatively small proportion of patients discontinued their vitamin D therapy. However, when this is translated to absolute numbers, the small proportion represents a considerable number of individuals. Discontinuation of vitamin D supplementation was associated with specific patient-related characteristics, which can help to inform

the development of targeted interventions and preventive strategies to improve support for patients at risk of discontinuing their treatment due to such policies.

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