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Review article

Nudging to assist opioid tapering among chronic non-malignant pain patients: A systematic scoping review

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ABSTRACT

Objectives: Use of opioids can lead to frequent and severe side effects, prompting the exploration of non-pharmacological alternatives, including nudging, to reduce opioid consumption. This review identifies and evaluates patient-targeted nudges to support opioid tapering among adults with chronic non-cancer pain.
Methods: We searched EMBASE, MEDLINE, CINAHL, PsycInfo, and Social Science citation index for articles published from 2010 to January 2023. Eligibility criteria were based on the PICOS framework and included original peer-reviewed English language studies on adults with chronic non-cancer pain and interventions aligning with the nudge definition by Thaler and Sunstein. Studies with relevant comparators, measurable outcomes, real-world data, and pre/post-intervention measures were included. Data were manually extracted and reported in a descriptive manner. The process adhered to PRISMA-ScR reporting guidelines.
Results: Four of 222 articles fulfilled the inclusion criteria. All included nudges aimed at providing information to support decision-making and behavior change. Three nudge categories were identified: increasing salience, understanding mappings, and feedback. Outcome measures were program-related, focusing on perceptions, knowledge acquisition, engagement metrics, and psychological well-being.
Conclusions: There were no statistically significant effects or only small evidence of effects in the program-related outcomes. None of the studies included a control group with standard care or no intervention comparison and none included objective measures of opioid reduction. More studies are needed to draw conclusions on the effectiveness of nudges to support opioid tapering among chronic non-cancer pain patients.

1. Introduction

1.1. Background

Chronic non-cancer pain (CNCP) is a complex and burdensome condition for both the individual and society (Sjøgren et al., 2009). The use of opioids to treat or manage pain is associated with frequent and potentially serious adverse effects, such as physical and psychological addiction, and cognitive dysfunction (Eccleston et al., 2017; Pitcher et al., 2019). It is also well known that for most people, the long-term beneficial effect of opioids on pain decreases over time (Ekholm et al., 2014; Pitcher et al., 2019). To diminish the problem, several policy responses have been introduced to limit opioid prescriptions. Several countries have implemented guidelines that discourage opioid prescription for CNCP (Busse et al., 2017; Chou et al., 2009; Dowell et al., 2016; Häuser et al., 2017). Instead, prescribers are encouraged to prioritize non-pharmacological alternatives and discuss opioid tapering with patients using opioids for CNCP (Busse et al., 2017; Häuser et al., 2017; White et al., 2021).

Knowledge about the effects of non-pharmacological interventions, e.g. cognitive behavioral therapy, on opioid tapering is limited, and the (few) studies have mixed findings (Eccleston et al., 2017; White et al.,

Abbreviations: CNCP, Chronic non-cancer pain; PICOS, Population, intervention, comparator, outcome, and setting; BOOK, Brief Opioid Overdose Knowledge; COMM, Current Opioid Misuse Measure; GAD, Generalized Anxiety Disorder screener.

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2021). In addition, the implementation and uptake of guidelines are challenging, and evidence indicates insufficient effectiveness of policy regulating initiatives on reducing opioid prescription (Sacks et al., 2021). To improve adherence to guidelines, clinician-targeted initiatives have been implemented. However, the effects of these interventions are mixed (Asamoah-Boaheng et al., 2021; Nwafor et al., 2021). In 2016, Frank et al. proposed patient engagement to be more important than tapering guidelines. They investigated patient perspectives on tapering of long-term opioid therapy and found patient motivation to be a crucial element to obtain a reduction and successful discontinuation of opioid use (Frank et al., 2016).

However, in the process of opioid tapering, a unique set of challenges emerges that are associated with non-rational behavior and cognitive biases in patients' decision-making. Unlike many other medical contexts, opioid tapering involves not only the apprehension of pain, for which alternatives are limited, but also dependency and potentially misuse. Therefore, patients may reject opioid tapering despite clinical recommendations and lack of effectiveness. This seemingly irrational decision-making could be due to insufficient decision-information, fear of pain apprehension or concerns about not being able to receive opioids again if needed. One promising method to address these cognitive biases and impact the motivation towards health-related behavioral change (supporting opioid tapering) is through nudging interventions (Thaler and Sunstein, 2009).

1.2. Nudge-theory, approaches, and techniques

Nudging is a concept originating from the field of behavioral economic theory which acknowledges that people do not always make the most appropriate decisions for their own health and welfare (Thaler and Sunstein, 2009). Nudging was introduced by Thaler and Sunstein in 2008, who defined it as "Any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler and Sunstein, 2009).

Since its introduction, several different frameworks for nudging have been developed, each with different characterizations of the nudging techniques (Dolan et al., 2012; Löfgren and Nordblom, 2020; Thaler and Sunstein, 2009). We apply the well-accepted characterization proposed by Thaler and Sunstein, who grouped nudges into six categories based on the intervention, or the underlying behavioral mechanism or cognitive bias it targets: 1) default choices, 2) reducing error, 3) providing feedback, 4) understanding mappings, 5) structuring complex choices, and 6) increasing salience of information/incentives (Thaler and Sunstein, 2009), see Table 1. An example of a nudge could be providing comprehensive information of opioid alternatives and present meaningful and easy-to-understand information on side effects of opioid use. This represents a nudge intervention, classified under the 'understanding mappings' category as it employs information as a tool to steer behavior and address decision bias, all while being cost-effective, non-coercive and inexpensive.

Compared to more traditional health interventions, nudge interventions hold the potential to accommodate misjudgments or non-rational behavior, reinforce motivation, and in a non-coercive manner, assist better decision-making and induce a behavioral change towards more rational behavior. It has been promoted as an alternative to implementing restrictions, as a nudge can potentially influence decisions in a predetermined way without legislation, and thereby preserve the individual choice and often at a lower cost than traditional interventions (Möllenkamp et al., 2019; Thaler and Sunstein, 2009).

1.3. Scope of research

In recent years, nudging has become increasingly applied within the area of public policy and health care (Meeker et al., 2014; Patel et al., 2018), and existing studies have shown some effect of nudging when applied against the abuse of benzodiazepines, alcohol, and tobacco (Darker et al., 2015; McQueen et al., 2011; Nurchis et al., 2023). Nevertheless, knowledge about patient-targeted nudges in the context of opioid tapering is lacking. This study adds to the literature by addressing this research gap. If effective, nudging may provide an easy, non-coercive, and inexpensive tool to assist opioid tapering which, considering the magnitude of the opioid crisis, holds significant value from individual, societal, policy, and health economic perspectives.

The aim of this scoping review is 1) to identify studies using patient-targeted nudge interventions to support adults using opioids to engage in behavior changes for managing CNCP, and 2) to evaluate the effect and type of nudge interventions in the described context.

Table 1
Nudge categories, definition, and examples.

Nudge-category based on choice architecture	Definition	Examples
Default choices	Structuring the set of choice alternatives such that the desired choice(s) is the one that follows "the path of least resistance". That means the choice alternative that will apply if no active steps are made to change them.	Automatically inclusion or enrollment in a particular program, service, or action unless the individual explicitly indicates their desire to not be involved.
Expect/reduce error	Designing systems using prompts and forced stops to reduce the occurrence of common error which are likely to occur due to human error.	Incorporating format suggestions, error prompts or visual cues to guide users towards accurate use.
Providing Feedback	Informing decision makers of their performance or consequences of their choices. This can influence future behavior as it enables them to align their behavior with desired outcomes.	Informing people of their performance relative to a set benchmark or peer average.
Understanding mappings	Helping decision makers to understand complex relationships between choice alternatives and their associated outcomes.	Provide comprehensive information about choice alternatives and present information in ways that are easy to understand and meaningful to the decision maker.
Structure complex choices	Divide the set choice alternatives or creating sorting mechanisms according to attributes, preferences or needs.	Presenting options based on previous choices or peer preferences. Or structuring choices around specific issues.
Increase salience	To provide information where information or incentive associated with choice alternatives are made more noticeable or attractive.	Use of text or color to highlighting text or displaying information in a novel manner.

Source: (Nwafor et al., 2021; Thaler and Sunstein, 2009).

2. Methods

2.1. Information source and search strategy

The scoping review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) framework (Tricco et al., 2018) (see Appendix A).

The search was carried out on the 4th of January 2023, and studies published between January 2010 and 2023 were included. The search was conducted in the following electronic databases: EMBASE (OVID), MEDLINE (OVID), CINAHL, PsycInfo (OVID), and Social Science citation

index (Web of science) to capture publications in both health and social science.

The search strategy built on block searches in the included databases and included a combination of both subject headings and free-text search terms in title and abstract. Search terms were constructed according to the PICOS (Population, Intervention, Comparator, Outcome, Study type) framework (Higgins et al., 2019). The search was based on the "population" and "intervention" items and adjusted according to the search options of the individual databases. The included search terms can be found in Appendix B. Search terms containing more than one word were combined with proximity operators to capture studies using similar phrases to describe the study. In addition, the search terms included truncation to capture different inflections of the terms.

2.2. Study selection

The search results were exported to Covidence. Covidence software was used to delete duplicates, and any remaining duplicates were removed manually. The main reviewer (SHN) conducted a title and abstract screening on the remaining articles based on the specified eligibility criteria below. The remaining articles were screened according to the eligibility criteria on full text, and in case of doubt, a co-author (LBP) was consulted. Fig. 1 shows a PRISMA flow diagram from the identification to the final inclusion of the studies according to the PRISMA statement (Tricco et al., 2018).

2.3. Eligibility criteria

The review included original peer-reviewed studies written in English language. Table 2 presents an overview of the applied eligibility criteria based on the PICOS framework (Higgins et al., 2019).

2.3.1. Population

The review included studies which investigate opioid consumption in adult patients (≥18 years) with CNCP.

Table 2
Eligibility criteria based on the PICOS framework.

	Inclusion criterions	Exclusion criterions
Population	Interventions targeted: • Patients with chronic non-malignant pain • Patients using opioids • Patients ≥ 18 years old	Interventions targeted: • Cancer patients • Patients =< 18 years old • Health professionals • Patients treated at dentists
Intervention	The intervention must fall under the definition of a "nudge" as defined in this study. See section "intervention". The term "nudge" is not mandatory	Interventions which are not considered nudges in/of themselves: • Some educational initiatives • Cognitive therapy or other therapy forms • Audit and feedback • Financial incentives • Non-financial incentives e.g., benefits, advantages, or privileges • Mandates, rules, regulations, and guidelines
Comparators	Studies must include at minimum one comparator: • No intervention • Standard treatment • Other treatment	Studies that do not include a comparator
Outcomes	Studies must include a measurable outcome	Studies that do not include an outcome
Study design	Studies must: • Use real world quantitative data • Include pre-and post-measures	Studies that are: • Qualitative • Cross-sectional • Not using real world data, e.g., laboratory experiments, literature reviews, and study protocols

2.3.2. Intervention

Based on the original nudge definition by Thaler and Sunstein (2009), nudge-interventions in this study were defined as an attempt to

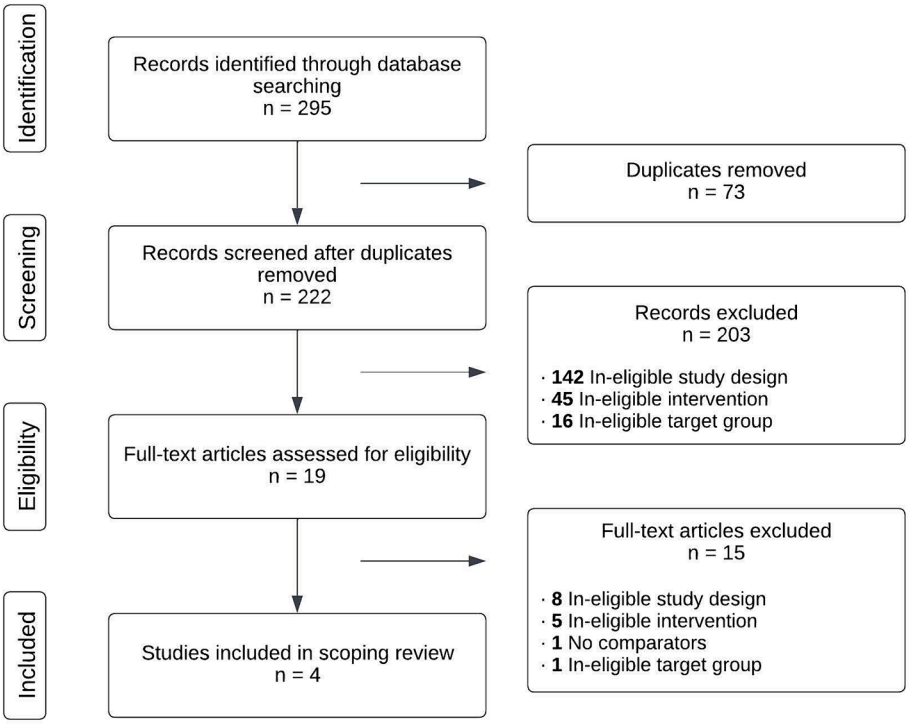

Fig. 1. PRISMA flow diagram of the study selection process.

influence patient behavior related to their consumption of opioids in a predictable way without forbidding any alternative options or significantly changing their economic incentives. The interventions needed to be easy and inexpensive to implement.

For studies to be included, at least one of their interventions had to adhere to the nudge definition by Thaler and Sunstein (2009). However, as there are several terms for the word "nudge" e.g. behavioral interventions, it was not a requirement that the studies used the word "nudge" or defined their intervention as a nudge or referred to Thaler and Sunstein (2009).

Even though cognitive therapy and other therapy forms, e.g., mindfulness, are important alternatives/supplements to opioids in the treatment, they were not included in this review as they do not comply with the definition of a nudge. The main cause for this is that they are considerably time-consuming, and implementation is associated with certain costs and efforts.

As in other systematic reviews (Mertens et al., 2021), educational programs involving more comprehensive, recurring, time-consuming, in-depth teaching were excluded, as they do not meet the premise of the nudge definition. However, in accordance with approaches by Thaler and Sunstein, studies with educational content that composed a discreet and subtle intervention aimed at influencing behavior by providing feedback or decision-relevant information in a way that could affect behavior without requiring a significant effort were considered nudges and were included (Sunstein, 2016; Thaler and Sunstein, 2009). The distinction between educational nudges and educational programs depends on a discretionary assessment in relation to the established criteria.

2.3.3. Comparators

Studies had to include at least one relevant comparator. Relevant comparators are no intervention, standard procedure, or other treatment.

2.3.4. Outcome

Studies also had to include a measurable outcome, measured at patient or clinic level.

2.3.5. Study design

Studies had to use real-world data and include pre- and post-intervention measurements so the effect of the nudge intervention could be quantified.

2.4. Data extraction, charting, and synthesis of results

Data were extracted manually from the articles and reported in a descriptive manner according to the PRISMA-ScR reporting guideline. A table for charting data was designed and filled with key characteristics compiled from each of the included studies. The following parameters were collected: author, publication year, country, objectives, study design and setting, target population, sample and interventions including comparators, outcomes/scales, analysis type, results. In addition, information on time spent on interventions, acceptability, and nudge category was collected. The process was performed by the main reviewer (SHN).

3. Results

A total of 222 studies were identified (Fig. 1). Of these, 203 were excluded mainly due to in-eligible study design (n = 142) e.g. protocols or in-eligible intervention type (n = 45). 19 studies proceeded to full-text review. During full-text screening, 15 studies were excluded. The most common reasons for exclusion were ineligible study design (n = 8) or ineligible intervention type (n = 5). A total of four studies included interventions that fit the study's definition of a nudge and chosen study design. These studies formed the final dataset and proceeded to data charting and extraction (Bergeria et al., 2019; Feng et al., 2021; Young et al., 2018; Young et al., 2020) (see Table 3).

3.1. General study characteristics

The four studies contained a total of three nudge interventions. The studies were published between 2018 and 2021. All were published in the United States and had a pre-test/post-test study design with study periods and follow-up times ranging from 0-12 weeks (Feng et al., 2021; Bergeria et al., 2019; Young et al., 2018; Young et al., 2020).

All four studies used an online setting, were self-administered by patients, and carried out individually. In total, two of the studies used the crowdsourcing platform Amazon Mechanical Turk for recruitment, and the online survey manager Qualtrics for delivery of the intervention (Bergeria et al., 2019; Feng et al., 2021). The remaining studies (n = 2) used the Institutional Review Board of the University of California Los Angeles health system for recruitment and delivered the interventions through Facebook (Young et al., 2018; Young et al., 2020).

3.2. Nudge category

The four studies all included some kind of educational content with the purpose of informing adult chronic pain patients about opioids, pain, and overdose to support decision-making and behavior change. However, the strategy of how to deliver the information and the nudge category varied between the four studies.

The study by Feng et al. (2021) (N = 239) compared a short narrative-based video versus an informal pamphlet as comparator (Feng et al., 2021). Both the intervention and potentially also the comparator could be grouped under the nudge category "understanding mappings" or "increase salience", see Table 1. In addition, as the intervention applied persons who previously used opioids as the messengers of information, the nudge uses social influences to promote a behavior change.

The study from Bergeria et al. (2019) (N = 119) delivered educational content in both the intervention and the comparator groups in form of educational slides (Bergeria et al., 2019). The educational slides were identical in the intervention and comparator groups and contained elements from both "increasing salience" and "understanding mappings", as they use pictures and educational descriptions. However, the intervention group had embedded corrective feedback in the slides, see Table 3, thus, the nudge tested falls under the category of "providing feedback".

The remaining two studies (Young et al., 2018N = 51, and Young et al., 2020N = 38) investigated the effect of adding peer-leaders to create a supportive and engaging community to a closed Facebook community. The intervention was enrollment to a peer-leaders Facebook group, and the comparator was enrollment to a Facebook group without peer-leaders (Young et al., 2018; Young et al., 2020). Both the intervention and the comparator contained elements from the "understanding mappings", "give feedback" and "increase salience" nudge categories. However, as the nudges were set up as a community, the nudges were based on social influence as the mechanism to affect participants. The inclusion of peer-leaders could, according to theory (Thaler and Sunstein, 2009), potentially increase the effect of social influence, as people most often like to follow authorities (Thaler and Sunstein, 2009). Thereby, the studies test the effect of different levels of social influence.

3.3. Effectiveness of interventions

Reported outcome measures were program-related and included measures of perceived effectiveness (n = 1), perceptions of tapering self-efficacy (n = 1) (Feng et al., 2021), perceived tapering intention (n = 1) (Feng et al., 2021), perceived tapering effectiveness (n = 1) (Feng et al., 2021), the Brief Opioid Overdose Knowledge (BOOK) scores (n = 1)

Table 3
Characteristics of the included articles and summary of results.

Citation, Year, Country	Objective	Design and setting	Population	Sample and intervention	Outcome	Scale	Analysis	Results
Feng et al, 2021, USA	Assess narrative based video's effective-ness in increasing patients' self-efficacy for tapering and intention to taper compared to an informational pamphlet on opioid tapering.	• Pre-test / post-test. • Online recruitment through mTurk. • Intervention delivered through the online survey manager Qualtrics.	Participants who • experienced pain most or all the time during the past 30 days, and • was suffering from pain for 6 months or longer, and • were prescribed opioids and taking opioids at least once a week, and • did not report a reduction in prescribed opioid dose during the past year.	N = 239. n = 128. A 13 min long narrative-based patient education video, consisting of small segments (30 s long each). n = 111. A 2 page long opioid tapering pamphlet, containing 565 words.	1. Perceptions of tapering effectiveness. 2. Perception of tapering self-efficacy. 3. Tapering intention.	Outcome 1—3: measured as an average of responses to 3 items measured on a 5-point Likert-scale.	Group differences analyzed using separate linear regression analysis. Participants' demographic characteristics and pre-intervention measures (pain intensity, pain related interference with life, perceptions of opioid effectiveness, concerns about opioids, or their preintervention tapering intention) are included as covariates in primary analyses.	• Sig. higher perceptions of tapering effectiveness in the video group (mean = 4.06) than the pamphlet group (mean = 3.67), adjusted mean difference = 0.34, 95 %CI 0.13 – 0.54, P < 0.001. • Sig higher perceptions of tapering self-efficacy in the video group (mean = 3.97) than the pamphlet group (mean = 3.60), adjusted mean difference = 0.32, 95 %CI 0.09 – 0.55, P < 0.001. • No sig. difference in tapering intention between intervention groups.
Bergeria et al, 2019, USA	Compare opioid overdose knowledge following a presentation or a presentation + mastery intervention and assessing 30-day knowledge retention.	• Pre-test/ post-test, 30-day follow up. • Online recruitment through MTurk • Intervention delivered through the online survey manager Qualtrics.	Participants were: • ≥18 years old, and • Current opioid users, and • Resided in the United States, and ≥80 % approval rate from completion of HIT. Allocated to risk group: • Acute pain. • Chronic pain. • No pain (illicit opioid use).	N = 119 n = 61. 25 educational slides with text, pictures, and/or videos about general opioid knowledge, opioid OD knowledge, and opioid OD response knowledge. n = 58. Same 25 educational slides but with embedded questions with corrective feedbacks. Achievement of ≥ 80 % accuracy to the questions were required to advance the intervention. If this was not achieved, participants had another opportunity to answer questions correctly. After 3 failures participants were automatically advanced to the next module.	OD knowledge/BOOK scores (measured pre- and post-intervention, and at 30-day follow-up): 1. General opioid knowledge. 2. Opioid OD knowledge. 3. Opioid OD response knowledge. 4. The BOOK total score. Past 30-day risk behavior, measured pre-intervention and at 30-day follow up: 5. Use of prescription opioids or heroin alone. 6. Use of pain pills or heroin parallel with alcohol. 7. Use of non-prescribed methadone	Outcome 1–3: Each outcome was measured as the sum of correct responses to 4 items (range 0–4) with response options "True", "False", or "I Don't Know". Outcome 4: Summation of the 3 subscores from outcome 1–3 (range: 0–12). Outcome 5–7: Measured dichotomously (yes/ no).	BOOK scores analyzed using RM ANOVA for: A. Main effect and interactions of intervention type on the 4 BOOK-scores across time. B. Main effects and interactions of each pain group, intervention type, and timepoint on the 4 BOOK scores. Bonferroni corrected post-hoc analyses were used. Past 30-day risk behaviors (chi-squared tests): Intervention type as a function of time. Pain groups as a function of time.	A. BOOK-scores across time: • Sig. increase from pre- to post-intervention and 30-day follow-up. 1. General opioid knowledge subscores, p < 0.001, 2. Opioid OD knowledge subscores, p < 0.001 3. Opioid OD response knowledge subscores, p < 0.001. 4. BOOK total scores, p < 0.001. • Small sig. decrease in outcome 1, 2, and 4 between post-intervention and 30-day follow-up, p's < 0.05. • No sig. effect on BOOK scores (outcome 1–4) between intervention and comparator group, p's > 0.05. B. BOOK-scores across pain groups: 1. Acute pain participants had sig. lower general opioid knowledge scores than the chronic and no pain groups, p < 0.01,

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Table 3 (*continued*)

Citation, Year, Country	Objective	Design and setting	Population	Sample and intervention	Outcome	Scale	Analysis	Results
								2. Acute pain participants had sig. lower opioid OD knowledge scores than the chronic and no pain groups, $p < 0.05$, 3. Acute pain participants had sig. lower opioid OD response knowledge scores relative to the chronic pain group, $p < 0.05$. 4. Acute pain participants had sig. lower BOOK total scores compared to the chronic pain participants across all time, $p = 0.001$. • No Intervention x Pain group interactions were observed for the BOOK total or sub scores (p's > 0.05). C. Changes in risky opioid use across time 5. Sig. fewer participants used opioids alone at follow-up (37.8 %) compared to pre-intervention (51.3 %), $p = 0.03$. 6. Sig. fewer participants reported using alcohol concurrently with opioids at follow-up (20 %) compared to pre-intervention (35 %), $p = 0.01$. • These results did not vary as a function of intervention, $p = 0.24$. 7. No sig. change in the frequency of individuals who used non-prescribed methadone at follow-up (5 %) compared pre-intervention (6 %), $p = 0.78$. D. Changes in risky opioid use across pain groups at follow-up. • Individuals with acute pain were less likely to

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Table 3 (*continued*)

Citation, Year, Country	Objective	Design and setting	Population	Sample and intervention	Outcome	Scale	Analysis	Results
								use alcohol with opioids when compared to individuals with no pain and illicit opioid use (27.6 % v. 39.0 %) but were more likely to use alcohol with opioids compared to individuals with chronic pain (27.6 % v. 17.3 %), p = 0.005).
Young et al, 2018, USA	Assess the feasibility of a 12-week HOPE social media-based support intervention to reduce risk of opioid misuse and OD among patients on chronic opioid therapy for chronic non-cancer pain.	• Pre-test/ post-test (12-week follow-up). • Online recruitment and enrolment through the UCLA health system. • Intervention delivered through Facebook.	Participants were: • UCLA health system patients, and • receiving chronic opioid therapy for non-cancer pain, and • ≥18 years old, and • at-risk for prescription opioid misuse/OD, and • had a COMM, 17 items questionnaire score >= 9, and/or self-reported concomitant use of opioids and benzodiazepines.	N = 51 n = 25. 12-week enrollment into a closed secret Facebook group moderated by 8 peer leaders/role models, to create a supportive and engaging community. n = 26. 12-week enrollment into a closed Facebook community group without peer leaders. After enrollment, participation in the online communities was voluntary.	1. Number of engaged participants. 2. Engagement score among the engaged participants, defined as the sum of posts, comments, and reactions. 3. Category of topics of posts and comments.	Outcome 1: Measured as those who posted, commented, or reacted at least once over the 12-week period. Outcome 2: Measured as the sum of posts, comments, and reactions. Outcome 3: Hand-coded into following topics: Physical health status, mental health status, pain, non-medication treatment, medication treatment, substance use disorder, coping, social support, and other topics.	Group differences analyzed using: A. chi-square test of independence for number of engaged participants. B. Two-sample *t* test for engagement score. C. Descriptive frequencies of post topics.	A. For each study period (week 1–4, 4–8, 8–12), a higher number of participants in the peer leaders' group were engaged compared to those in the comparator group. This difference was only sig. during the first study period (weeks 1–4), p = 0.05. B. Participants in the peer leaders' group had a sig. higher engagement score across all time periods, compared to those in the comparator group, p < 0.001. The average score for the 12 weeks were 1.25 vs. 8.20, p < 0.001. • Over the 12-week period, 19 out of 26 participants (73 %) in the peer leader group provided a total of 411 posts or comments. In contrast, 13 out of 25 participants (52 %) in the comparator group provided a total of 45 posts or comments. C. The peer leaders group posted about the following topics: Coping (33 %), physical health status (32 %), medication treatment (27 %), pain (26 %), nonmedication treatment (24 %), mental health status (21

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Table 3 (*continued*)

Citation, Year, Country	Objective	Design and setting	Population	Sample and intervention	Outcome	Scale	Analysis	Results
								%), and social support 19 %). The group without leaders primarily focused on their personal clinical experiences. Out of the 45 posts and comments posted by the group, > 50 % were attributed to the following topics: Physical health status (56 %) and medication treatment (53 %).
Young et al, 2020, USA	Assess the feasibility and preliminary efficacy of using a HOPE Facebook community, compared to a comparator Facebook community, with a special focus on whether the intervention translates to reduced anxiety and opioid misuse among non-cancer opioid patients.	• Pre-test/ post-test (12-week follow-up). • Online recruitment and enrolment through the UCLA health system. • Intervention delivered through Facebook.	Participants were: • UCLA health system patients, and • Prescribed opioids for non-cancer chronic pain between 3–12 months ago, and • ≥18 years old, and • at-risk for prescription opioid misuse/OD, and • receiving a COMM, 17 items questionnaire score >= 9, and/or self-reported concomitant use of opioids and benzodiazepines	N = 38 with complete baseline and follow-up assessment. n = 20. 12-week enrollment into a closed secret Facebook group moderated by peer role models. 3 peer leaders attended the group, to stimulate conversations about pain and personal experiences and not clinical recommendations. n = 18. 12-week enrollment into a closed Facebook community group without peer leaders. After enrollment participation in the online communities was voluntary.	1. Social media communication. 2. COMM-17 scores. 3. GAD-7 scores.	Outcome 1: Coded into following topics: pain, prescription opioid use, coping strategies, places to seek help, alternative therapies for pain, and illegal substances to help address pain. Outcome 2: Measured as the sum of scores on a 17-items questionnaire where each item is rated on a 5-point scale ranging from 0 to 4. The total COMM score range from 0 to 36 and a score >= 9 is the cut-off point for opioid misuse. Outcome 3: Measured as the sum of scores to 7 items rated on a 4-point scale rating from 0 to 3. The total GAD-7 score range from 0 to 21.	Group differences analyzed using: A. chi-square test of independence to compare social media communication. B. Paired *t*-test to compare COMM and GAD-7 scores pre- and post-interventions (12-week follow-up).	A. Post intervention (12 weeks) participants in the peer leader group used social media to discuss their pain, prescription opioid use, coping strategies, places to seek help, and alternative therapies for pain sig. more frequent compared to the community group without peer leaders, p ≤ 0.02. No sig. difference between groups in discussions about illegal substances to help address pain, p = 0.11. B. The peer leader intervention group showed: • Sig. reduction in GAD-7 score from pre- to post intervention, p = 0.04, translating a reduction from moderate to mild anxiety. • Sig. reduction in COMM scores from pre- to post intervention, p = 0.03. The community group without peer leaders showed: • no sig. changes in GAD-7 from pre- to post intervention, p = 0.58. • Sig. reduction in COMM scores, p = 0.02.

Source: (Bergeria et al., 2019; Feng et al., 2021; Young et al., 2018; Young et al., 2020).
Abbreviations: BOOK (Brief Opioid Overdose Knowledge), COMM (Current Opioid Misuse Measure), GAD (Generalized Anxiety Disorder screener), HIT (Human Intelligence Task), HOPE (Harnessing Online Peer Education), IQR (Interquartile range), mTurk (Amazon Mechanical Turk), OD (Overdose), RM ANOVA (Repeated measures analysis of variance), Sig. (Significant/significantly), UCLA (The Institutional Review Board of the University of California Los Angeles), USA (United States of America).

(Bergeria et al., 2019), changes in risky opioid use (n = 1) (Bergeria et al., 2019), number of engaged participants (n = 1) (Young et al., 2018), number of posts (n = 1) (Young et al., 2018), theme of posts (n = 2) (Young et al., 2018; Young et al., 2020), the Current Opioid Misuse Measure (COMM) scores (n = 1) (Young et al., 2020), and the Generalized Anxiety Disorder Screener (GAD-7) scores (n = 1) (Young et al., 2020). The BOOK scores stem from a validated questionnaire used to assess overdose knowledge in persons with opioid use disorder (Bergeria et al., 2019). The COMM scores stem from a questionnaire used to monitor chronic pain patients on opioid therapy for aberrant medication-related behaviors and elevated risk opioid misuse (Young et al., 2020). The GAD-7 is a diagnostic tool which uses the clinical diagnostic criteria for generalized anxiety disorder from the Diagnostic and Statistical Manual of Mental Disorders (Young et al., 2020).

In the comparison of the effectiveness of a narrative-based video in enhancing patients' self-efficacy for opioid tapering versus a pamphlet on opioid tapering, the video group exhibited statistically significant higher levels of perceived tapering effectiveness and self-efficacy for tapering in comparison to the pamphlet group. However, when evaluating patients' intention to undergo tapering, no statistical difference was found between the two groups. Perceived tapering effectiveness refer to an individual's subjective beliefs or assessment of how effective the intervention will work in achieving successful tapering. Perceptions of tapering self-efficacy refer to an individual's subjective beliefs about their own capability to successfully undertake tapering (Feng et al., 2021).

Bergeria et al. showed no statistically significant difference on BOOK scores when comparing the BOOK-scores of the intervention (with embedded corrective feedback) to the comparator (Bergeria et al., 2019). However, comparing the effectiveness in obtaining opioid overdose knowledge across time within the intervention and the comparator, both groups statistically significantly increased general opioid knowledge, opioid overdose knowledge, opioid overdose response knowledge, and BOOK total score from pre- to post-intervention and 30-day follow-up. However, a slight decrease in general opioid knowledge, opioid overdose knowledge, and BOOK total score was seen from post-intervention to follow-up when assessing the 30-day knowledge retention. When comparing the BOOK scores within pain groups between the intervention and the comparator groups, no statistically significant differences in BOOK scores were found (Bergeria et al., 2019).

Bergeria et al. neither found any statistically significant difference between the intervention and the comparator groups in using opioids alone or using alcohol concurrently with opioids from pre-intervention to follow-up. Also, there was no statistically significant difference in the percentage of participants reporting use of non-prescribed methadone at follow-up compared to pre-intervention between the intervention and comparator groups. However, within the intervention group and the comparator group respectively, significantly fewer participants reported using opioids alone as well as using alcohol concurrently with opioids at follow-up compared to pre-intervention (Bergeria et al., 2019).

Exploring the feasibility and preliminary efficacy of a harnessing online peer education Facebook community with peer-leaders, compared to a comparator Facebook community without peer-leaders, the peer-leaders' group in general presented with a higher number of engaged participants compared to the group without peer-leaders (Young et al., 2018). The difference was statistically significant during the first four weeks of the study. The number of engaged participants, however, declined in both groups over time (Young et al., 2018). The participants' engagement score was statistically significantly higher among the peer-leaders' group versus the comparator group (Young et al., 2018). The discussions in the peer-leaders' group were broader and included chronic pain and opioid related topics such as describing personal experiences with their pain, different treatments, and satisfaction with meeting patients with similar experiences. The discussion in the group without peer-leaders were primarily focused on personal

clinical experiences (Young et al., 2018).

Young et al., 2020 measured the COMM- and GAD-7 scores pre-intervention and post-intervention. Both the intervention group and the comparator group showed a statistically significant reduction in COMM scores from pre intervention to follow-up, but only the peer-leaders group obtained a statistically significant reduction in GAD-7 scores. No comparison between the intervention group and the comparator group was performed (Young et al., 2020). In this study participants in the peer-leader group discussed their pain, prescription opioid use, coping strategies, places to seek help, and alternative therapies for pain statistically significantly more frequent compared to the group without peer-leaders. However, there was no statistically significant difference between the two groups in discussions about illegal substances to help address pain.

3.4. Acceptability and time spent

Only one study examined the acceptance of the interventions directly (Bergeria et al., 2019). Acceptance was measured among participants post-intervention, utilizing a measure consisting of 13 items categorized into four domains. These domains included general acceptability, belief in the intervention's efficacy in preventing future overdoses, anticipated impact on their assistance to others experiencing an overdose, and likelihood of recommending the intervention to family members or friends (Bergeria et al., 2019). The results revealed no statistically significant differences in intervention acceptability between the intervention and comparator across any of the measured items (Bergeria et al., 2019). This suggests that both the intervention group and the comparator group exhibited similar levels of acceptance of the nudge. However, participants in the intervention group with corrective feedback spent statistically significantly more minutes (9 more minutes on average) completing the presentation than the comparator group, and a statistically significantly higher proportion of participants dropped out (20.4 percentage points more dropped out) after initiating the presentation with corrective feedback compared to the comparator presentation (Bergeria et al., 2019).

3.5. Payment

All studies offered participants payment for participating in the studies. Feng et al. offered $0,30 for screening participation, and $1 for participating in the intervention/comparator (Feng et al., 2021). Bergeria et al. offered $0.10 for screening participation, and $5 for completion, and an additional $2 for completing follow-up (Bergeria et al., 2019).

Young et al. 2018 and 2020, provided online gift cards to participants with a value of $30 to complete the screening and baseline assessment, and online gift cards with a value of $40 to complete the assessment at the 12-week follow-up. Peer-leaders were paid in online gift cards for completing tracking sheets every week; $30 for the first four weeks, $40 for the second four weeks, and $50 for the last four weeks (Young et al., 2018).

4. Discussion

This study reports on the effectiveness of nudges as behavioral interventions to support behavior changes in adults with CNCP. The very small number of included studies in this search highlights the limited evidence available.

4.1. Effectiveness of nudge interventions

The effectiveness of the nudge interventions included in the reviewed studies was assessed using various outcome measures, primarily focusing on program-related perceptions, knowledge acquisition, engagement metrics, and psychological well-being.

Overall, there were no statistically significant effects or only small evidence of effects in the program-related outcomes such as perceptions of opioid tapering. It is, however, important to acknowledge that the lack of a direct comparison to standard care or a "precede as usual" comparator group in the included studies limits the ability to determine the absolute effectiveness of the interventions compared to the absence of any intervention. Future research that includes such comparisons would provide valuable insights into the benefits of nudge interventions in the context of opioid tapering among CNCP patients.

In addition, it is important to note that only one study included self-reported opioid use behavior (Bergeria et al., 2019). However, even though statistically significantly fewer participants reported to use opioids at follow-up compared to pre-intervention, this difference was not statistically different between intervention and comparator. Therefore, the evidence of effectiveness of nudge interventions in achieving substantial changes in actual opioid use behavior remains poor or uncertain according to our findings. Future research should focus on incorporating objective measures of opioid reduction to provide more robust evidence regarding the effectiveness of nudging interventions in supporting opioid tapering among CNCP patients.

The limited evidence of effect found in this review might be due to study design features such as the design of the nudge intervention or time exposed to the intervention. In 2022, two studies, not included in this review, as participants did not meet the inclusion criteria of having chronic pain, investigated patient perceptions about three opioid risk communication tools at the emergency department (Dolan et al., 2022; Meisel et al., 2022). The studies found that educational nudges hold the potential to engage the patient in the decision-making process and reduce preferences for opioids at discharge (Dolan et al., 2022; Meisel et al., 2022). Using nudges as an engagement strategy corresponds well with the findings from Frank et al., 2016, who state that patient engagement is crucial to support opioid tapering (Frank et al., 2016).

4.2. Types of nudges

The interventions often contained elements that overlapped across multiple nudge categories (shown in Fig. 1), making it challenging to assign them strictly to a single category. This highlights the need for further exploration and refinement of nudge categorization frameworks to capture the multifaceted nature of interventions accurately. In addition, the assessment of nudge types was challenged due to lack of availability of intervention/comparator content through the articles.

The limited representation of nudge categories suggests a need for further research in this area as it is not possible to conclude on the effectiveness of different nudge categories. Future studies could explore the effectiveness of additional nudge categories to expand the repertoire of nudges available for supporting behavior change in this population, as well as investigate whether some categories prove more effective within this area. In addition, future studies should be very clear when describing the nudge intervention in relation to type and which behavioral theories they rely on.

4.3. Recruitment site and delivery form

All four studies employed an online setting with self-administered interventions. This reliance on online platforms for recruitment and intervention delivery introduces potential limitations and biases. Two of the studies utilized the crowdsourcing platform Amazon Mechanical Turk for participant recruitment and the online survey manager Qualtrics for intervention delivery (Bergeria et al., 2019; Feng et al., 2021). These platforms allow researchers to access a large pool of potential participants. However, it is important to recognize that the participants recruited through these platforms may not represent the broader population of CNCP patients who use opioids. The decision to participate in online studies may be influenced by various factors, such as internet access, technological literacy, and motivation to engage in online

research. As a result, the sample obtained through these platforms may not be fully representative of the target population, potentially leading to selection bias and lack of generalizability. This is also indicated in Feng et al., with a mean age of the participants of 37 years, whereas the average age of patients taking opioids against chronic pain tends to be around 45–65 years (Pitcher et al., 2019). As younger participants often are accustomed to obtaining information through online platforms, they might be more open to and respond positively to online nudge interventions. Also, older patients often have more comorbidities adding complexity to their situation, and may have had longer continuous use. Consequently, they might also be more difficult to taper off opioids and not respond to a nudge. However, this aspect is not represented in the studies if they do not participate.

The remaining two studies recruited participants through the Institutional Review Board of the University of California Los Angeles health system and delivered the interventions through Facebook (Young et al., 2018; Young et al., 2020). While utilizing a healthcare institution for recruitment may enhance the clinical relevance of the sample, the use of Facebook as the intervention delivery platform also introduces potential biases. Participants who are active on Facebook and comfortable engaging in online discussions may have different characteristics compared to those who are not active on social media platforms. This, again, raises concerns about the representativeness of the sample.

4.4. Payment for participation

The inclusion of studies that offered payment for participation raises the question of whether it aligns with the definition of a nudge, as nudges are typically designed to influence behavior without providing monetary incentives. However, it is important to acknowledge that in the studies included in this review, the payment provided to participants was relatively modest and a normal formality when recruiting through mTurk. Yet, there is quite some difference in the payment sizes spanning from $0.5 to $40.

While these payment amounts may not be substantial, they do serve as a monetary incentive for participation, and thereby also induces potential selection bias. The monetary incentives may attract individuals who may not have otherwise participated or may have different motivations compared to those who would participate without payment. This can potentially affect the generalizability of the findings.

4.5. Limitations

The criteria for English language studies may have excluded relevant studies published in other languages. Furthermore, study inclusion was complicated as not all studies were defined as nudge interventions. This resulted in individual evaluation of the intervention content and its correspondence with the nudge definition introduced by Sunstein and Thaler. Several studies examined either multiple nudge categories or treated them as part of a multifaceted intervention. When multiple nudge categories are compared without comparison to standard care or a “proceed as usual” comparator group, this renders the effectiveness assessment of the nudges difficult. In multifaceted interventions, e.g., studies using a nudge as a component together with other interventions such as cognitive behavioral therapy it is not possible to isolate the effect of the nudge from the intervention, and such studies have therefore been excluded.

5. Conclusion

Four studies were included in this review. We identified educational nudges as the primary approach employed to support opioid tapering among CNCP patients. The utilized nudge categories were increasing salience, understanding mappings, and feedback, in combination with different degrees of social influence. The studies primarily focused on program-related perceptions, knowledge acquisition, engagement metrics, and psychological well-being as outcome measures, to which the results showed either no statistically significant effect or only small evidence of effect when compared to the comparator group. However, none of the studies included a comparison to standard care or doing nothing. Hence, based on the included studies, there is insufficient evidence to make any conclusions on the effectiveness of nudge interventions to support opioid tapering among CNCP patients.

The limited number of studies highlights the need for additional research. More comprehensive high-quality studies are needed to assess the effectiveness of different nudge categories and to expand the repertoire of nudges available for supporting behavior change in this population. Future research should focus on incorporating objective measures of opioid reduction to provide more robust evidence regarding the effectiveness of nudging interventions in supporting opioid tapering among CNCP patients.

Ethics approval and consent to participate

According to Danish guidelines, Act on Research Ethics Review of Health Research Projects, this study does not need any ethics approval.

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CRediT authorship contribution statement

Sabrina Hoffensitz Nielsen: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Merethe Kirstine Kousgaard Andersen:** Writing – review & editing, Methodology, Conceptualization. **Jens Søndergaard:** Writing – review & editing, Methodology, Conceptualization. **Line Bjørnskov Pedersen:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Search strings are shared in Appendix B

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2024.102821.

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