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Please mind the gap between guidelines & behavior change: A systematic review and a consideration on effectiveness in healthcare

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ABSTRACT

Background & Objective: This systematic review evaluates the impact of guidelines on healthcare professionals' behavior and explores the resulting outcomes.
Methods: Using PRISMA methodology, Scopus and Web of Science databases were searched, yielding 624 results. After applying inclusion criteria, 67 articles were selected for in-depth analysis.
Results: The studies focused on key clusters: Target behaviors, Effectiveness, Research designs, Behavioral frameworks, and Publication outlets. Prescription behavior was the most studied (58.2 %), followed by other health-related behaviors (31.3 %) and hygiene practices (10.4 %). Significant behavior changes were reported in 46.3 % of studies, with 17.9 % showing negative effects, and 22.4 % reporting mixed results. Quantitative methods dominated (56.8 %), while qualitative methods (19.4 %) and review designs (13.4 %) were less common. Theoretical Domain Framework (TDF) and Behavior Change Wheel (BCW) were frequently used frameworks, with the UK and the USA contributing most studies. Medical doctors (44.8 %) were the primary participants, followed by general healthcare providers (37.3 %).
Conclusions: The study highlights the varied effectiveness of guidelines, with prescription behavior being the most investigated. Guidelines influenced behavior positively in less than half of the cases, and doctors were the primary focus, rather than nurses. The complexity of interventions suggests a need for further research to develop more effective behavioral interventions and to standardize methodological approaches to reduce clinical variation in healthcare.

1. Introduction

For more than two decades, research initiatives around the globe, such as the Dartmouth Atlas Project, have documented "glaring variations in how medical resources are distributed and used" [1]. Consequently, academics and practitioners alike have long placed the reduction of unwanted variation at the top of health policy agendas [2]. The Institute of Medicine defines Clinical Practice Guidelines (CPGs) as "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances" [3]. They have proven an effective tool for achieving this goal. Indeed, Kahneman et al. [4] call for more widespread adoption of guidelines because they have greatly improved public health by reducing both systematic mistakes and unwanted variability in medical decision-making.

As the interest in guidelines stretches across continents and their adoption diffuse into healthcare practice, research has shown that not all guidelines are created equal, and potential limitations and harms of clinical guidelines exist alongside their benefits [5]. Among the possible disadvantages of guidelines, some authors have focused on implementation issues whereby "the development of good guidelines does not ensure their use in practice" [6]. Indeed, evidence exists that it takes >17 years for guidelines to be implemented in healthcare organizations, and only about half of these guidelines are widely adopted [7,8]. This missed opportunity deserves great attention and requires research to understand why and under what conditions clinical practice guidelines may or may not lead to desired changes in professional behavior. This literature review will focus on behavior change as expected output from the implementation of CPGs.

Although research into strategies for changing professional behavior has long demonstrated that relatively passive methods of communicating guidelines, for instance, through professional journals or printed

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educational material to targeted healthcare professionals, are rarely effective in changing professional behavior [9], much remains to be discovered about the mechanisms behind guidelines' effectiveness. For instance, Rosanna Nagtegaal et al. [10] conducted a study with a particular focus on the use of nudges (any aspect of choice architecture that predictably alters people's behavior without restricting options) in healthcare. Authors provided an overview of how nudging healthcare professionals can support the implementation of evidence-based medicine (EBM) addressing the challenges of translating medical evidence into practice. They pivot on the dual-process model of human cognition: System 1 and System 2, as introduced by Kahneman [11]. While our aim is not to delve deeply into these concepts, it's important to note that humans generally process information through these two systems. System 1 Thinking is fast, automatic, and intuitive, operating with little to no effort, making it prone to biases (systematic deviations from rational judgment); in contrast, System 2 Thinking is slow, deliberate, and conscious, requiring intentional effort. One promising approach to mitigating biases is the use of nudges. Given that, a key element of modern EBM is that knowledge should inform, but not necessarily dictate, healthcare decision-making, therefore nudges could be the cornerstone for translating evidence into practice.

In their work they did consider the techniques designed to affect decision-making using processes from System 1. Their paper demonstrated that nudges success appears to vary in terms of three contextual characteristics: a) Task: Tasks that are widely accepted, such as hand hygiene, are more suitable to nudging, therefore, some outcomes would seem less appropriate to nudging; b) Organizational: Physicians in a large city hospital have been found to react differently than a rural physician. Nurses during the night shift might not be influenced by nudges that are effective during the day shift; c) Occupational contexts: Success depends on the professional that is working with the nudge, for instance, academic physicians might be more aware of guidelines, influencing their reaction to nudges and newly qualified residents might be more susceptible to nudges than more experienced physicians.

Differently from Nagtegaal et al. [10] the objectives of this paper were broader as we intended to evaluate the impact of guidelines on behavioral practices of healthcare professionals and to explore the resulting outcomes from these behavioral modifications. We aimed to address the following questions:

1) What is the current state of the literature regarding the relationship between CPGs and the behavioral practices of healthcare professionals, and what are the resulting outcomes?
2) Is there a gold standard or a standardized approach for implementing behavior changes in healthcare settings that takes guidelines into account?
3) What types of guidelines are being utilized, and which specific behaviors are they targeting?
4) What outcomes are associated with the implementation of these CPGs?

The first research question addresses the state of the art in this field. Our goal is to analyze the distribution of studies across different countries and identify which regions dominate the literature. The second question investigates the types of frameworks employed and their prevalence, with a particular focus on identifying a gold standard. There are many common theoretical frameworks for studying and applying behavior change, such as Knowledge Translation (KT), the Theoretical Domains Framework (TDF), the COM-B model, and the Behavior Change Wheel, but our aim is to go beyond conceptual frameworks and seek a unifying theory. For instance, while the TDF has been successfully applied in various Western acute and primary care settings, its scope of application remains limited [12].

The third and fourth points address the challenging issue of developing scientific guidelines. Crafting these guidelines is a detailed process that requires several stages and the cooperation of expert panels. Given that guidelines are intended to provide evidence-based recommendations for clinical practice and help healthcare professionals make informed decisions [13], we sought to determine whether authors within the publications evaluated best practices for effectively implementing clinical guidelines that could influence healthcare professionals' behavior.

Our systematic review aims to help fill this knowledge gap by comprehensively mapping the relationship between guidelines and behavioral changes among healthcare professionals (*humans* vs *econs*), identifying the factors that convey this relationship, as well as the methodologies adopted in this area. To achieve this goal, we conducted a systematic review (SR) without a meta-analysis, as a meta-analysis was not feasible given the included papers. This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. [14].

2. Materials & methods

2.1. Search strategy

To understand the correlation between *guidelines* and *behavior change*, we used the PICO(T) framework to define each element of the research question, see Table 1.

Accessing the Medical Subject Headings (MeSH) we looked for variants of keywords to operationalize the research. To overcome the ambiguity between British (e.g., behaviour) and American English (e.g., behavior), and to include the plural nouns, we used truncation (asterisk *). We used the following search strings: "Health Care Provider*" OR "Provider Health Care" OR "Healthcare Provider*"OR "Provider Healthcare" OR "Healthcare Worker*" OR "Health Care Professional*" OR "Professional Health Care" OR "practitioner*" OR "doctor*" OR "nurse*" OR "clinicians" OR "surgeon*" AND "Guideline*" OR "Best Practice*" OR "Evidence Based Medicine" OR "Evidence Based Nursing" AND "Behavio*ral change" OR "prescription behavio*r" OR "change in behavio*r" OR "change in behavio*r practice"

Sequentially, we searched only for journal articles on *behavior change* and *guidelines* in Scopus and Web of Science on March 16, 2022. On Scopus, we used the ARTICLE TITLE/ABSTRACT/KEYWORDS function, while on Web of Science, we selected the TOPIC option. No search filters were applied.

2.2. Study selection and inclusion/exclusion criteria

We included articles that focused on behavioral insights interventions and guidelines. We considered behavioral insights to encompass both established frameworks (such as Knowledge Translation - KT, the Theoretical Domains Framework - TDF, the COM-B model, and the Behavior Change Wheel), constructs derived from prospect theory, and articles related to behavior even if the authors did not explicitly mention these frameworks [15].

The inclusion criteria required that studies be published from 2013 onwards and indexed in databases such as Scopus and Web of Science. Both qualitative and quantitative studies were considered, alongside commentaries, guidelines on implementation, and research focused on

Table 1
PICO(T) framework breakdown.

PICO(T)	Subject
Population	Healthcare professionals
Intervention/Exposure	Guidelines
Comparison	NA
Outcomes	Behavior change
Timeframe	NA*

* The timeframe was set later after data extraction; for more details, see Inclusion/Exclusion criteria.

behavior change. The study prioritizes literature involving healthcare professionals across various disciplines, including nursing, medicine, and surgery, and covers a broad range of healthcare dimensions such as surgery, counseling, and education. Both primary and secondary studies were included to provide a comprehensive understanding of the topic. Conversely, the exclusion criteria were designed to filter out studies published before 2012, conference papers, books or book sections, non-English articles, study protocols, and reports that could not be retrieved (see Table A in the Appendix for the full list of inclusion/exclusion criteria).

2.3. Study outcomes of interest

In this review, the primary focus on outcomes was designed to identify whether changes were positive, negative, or null. We categorized results reported by authors as positive if they aligned with the expected direction of change, in more simple way, if the implementation of the guidelines produced a change in the direction expected by the authors. Negative if they went in the opposite direction of what was anticipated, and as null if the implementation of guidelines resulted in no detectable change.

2.4. Data extraction

Our initial research found 624 elements, of which 196 were from Web of Science and 428 were from Scopus. Using Zotero (version 6.0.6), we found that 155 out of 624 were duplicates. The process is shown in PRISMA 2020 flow diagram, see Fig. 1. Articles were screened, in a blind manner (e.g., concealing the journal's impact factor, journal's type/name, and authors' names), according to inclusion and exclusion criteria. At the end of the selection process, 383 elements were manually ruled out, and 86 articles were deemed potentially eligible for the SR. Thus, we sought for retrieval of all 86 publications. Only 1 wasn't recovered. During the last screening phase, of 85 studies remaining, only 67 were deemed eligible. This group was coded in full in an Excel file where data was categorized according to authors name, year of publication, type of journal, country, target behavior, effectiveness, research methodology, guideline source and behaviors framework, PICOT, and major findings.

2.5. Data analysis

A thematic analysis was then performed using the categorized data within the Excel file. Baseline characteristics were reported as Counts (N°) and Percentages (%) as appropriate. Data were assessed using jamovi software, version 2.2.5 [16,17]. Due to the types of studies

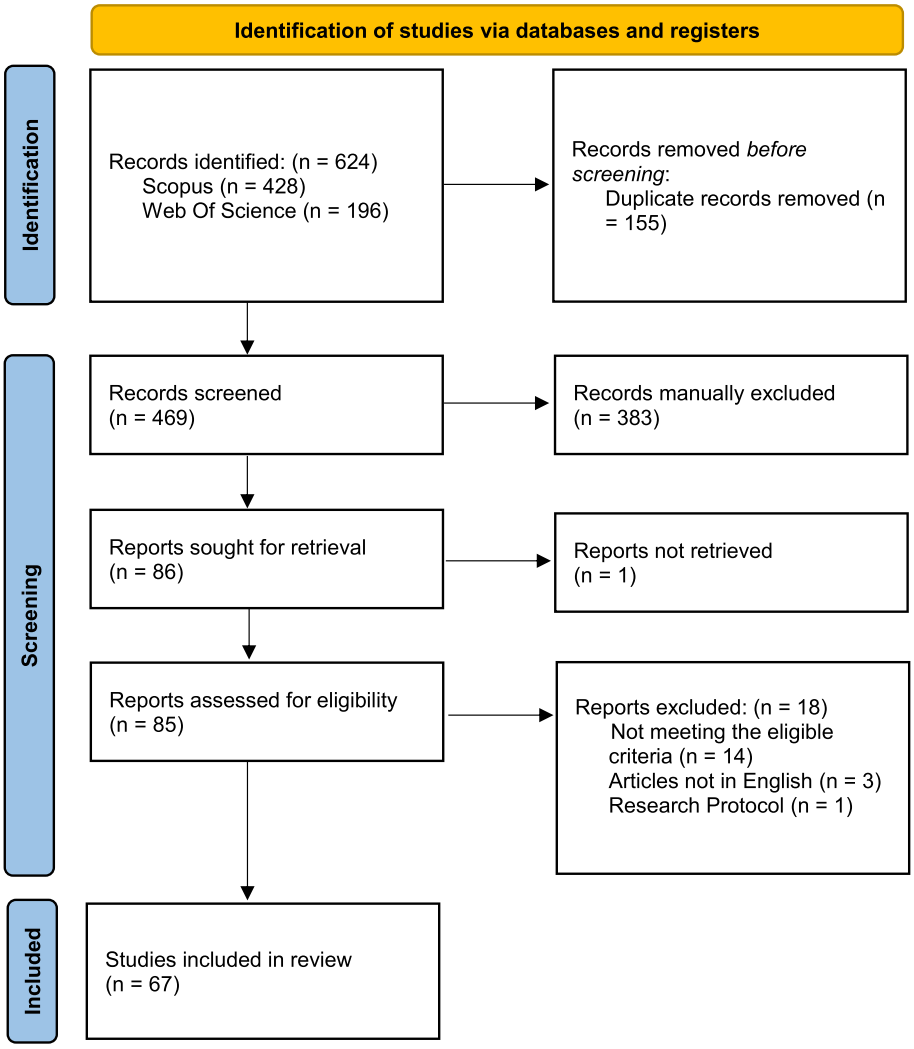

Fig. 1. PRISMA flow chart of study selection process.

retrieved a meta-analysis was not conducted.

3. Results

3.1. Overall data description

At the end of the review process, 67 studies were included in the analysis. Considering all 67 articles, six dimensions were extrapolated and successively developed in dedicated sections to investigate the research objectives. The six clusters were the following:

1) Target behaviors
2) Effectiveness
3) Research designs
4) Behavioral frameworks and publication outlets
5) Countries and distribution of articles per year
6) Participants and type of guidelines

Generally, 58.2 % of papers focused on prescription behaviors, 31.3 % studied other types of behaviors, and 10.4 % focused on hand hygiene practices and infection prevention and control (IPC). IPC is intended, according to WHO, as a practical, evidence-based approach that prevents patients and health workers from being harmed by avoidable infection or as a result of antimicrobial resistance [18].

Regarding effectiveness, 46.3 % of articles, 31 out of 67, reported effective and significant changes in behavior. The mixed results cluster (a combination of effective, opposite, not significant, and missing information about significance) gained second place with a percentage of 22.4 %, 15 out of 67 articles, followed by 17.9 % of publications that registered a negative outcome. 5 articles reported a not significant result or missing information about significance.

Quantitative methodology was the most frequent research design adopted, 56.8 %, while we encountered 17.9 % of qualitative papers, 13.4 % of review design, and 11.9 % for theoretical approach. By exploring the behavior frameworks section, the most frequently encountered were the Theoretical Domain Framework (TDF), the Behavior Change Wheel (BCW), Knowledge Translation (KT), and Educational Outreach Visit.

Of the 67 articles included, the top contributors were published by BMC Health Services Research (4 articles), which is listed within the Scopus subject area of *Medicine – Health Policy*, followed by PLoS ONE (3 articles) itemized in *Multidisciplinary*. The top contributors were the UK and the USA, with 9 and 5 articles, respectively. Australia and Canada had 14 papers (7 each), while Belgium and Germany published 8 papers, 4 in each country. Analyzing the annual distribution of publications, we found a peak of published articles during 2015, 2020, and 2021 (10, 13, and 12) accounting for 52.2 % of all papers included.

As expected, the most represented participants were medical doctors (MD), who were observed in 44.8 % of all publications, followed by a general category of healthcare providers and clinicians, both 37.3 %. Generally, we found that only 55.2 % (37 out of 67) of scientific works cited the source of the guidelines. In this case, 75.7 % of the scientific guidelines were redacted by scientific associations. International organizations such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) appeared in 7 papers, while local entities in 2 cases.

3.2. Target behaviors

All 67 articles were clustered according to three main categories:

1) Prescription Behaviors mainly include behaviors of antibiotics prescriptions and use, and general prescription (adherence to treatment guidelines, other drugs use and prescription, treatment of diseases, follow-up tests, self-medication). There are also specific categories, such as opioids and benzodiazepine prescriptions; studies on medicines used for depressive disorders and chronic obstructive pulmonary disease (COPD); examination (e.g., overuse of imaging in low back pain), and implementation of guidelines, e.g., in case of obesity, weight loss, and cardiovascular disease (CVD). [19–57]
2) Other Behaviors includes studies on mixed topics like infection prevention and control (IPC); patient care; musculoskeletal disorders; physical inactivity; risk prevention; medication adherence; early detection of chronic obstructive pulmonary disease (COPD); early oral feeding (EOF); injuries, and rehabilitation. In this cluster, only 3 articles were not assigned to a specific health condition. [58–78]
3) Hand Hygiene focuses on practices for infection prevention and control (IPC), e.g., in the case of COVID-19, surgical hand hygiene, and hand hygiene compliance. [79–85]

Prescription Behavior articles were the most represented in this systematic review, in fact, they cover 58.2 % of all articles included, followed by Other Behavior at 31.3 %, and the Hand Hygiene category at 10.4 %. See Table 2 for more details.

3.3. Effectiveness

During the final analysis, we introduced two additional categories, as noted in paragraph 2.3: "mixed effects" and "not assigned." The "mixed effects" category was used for studies with varying outcomes, while "not assigned" was applied when outcomes could not be definitively determined. Therefore, effectiveness (positive, negative, null, mixed effects, not assigned and missing information regarding the significance of their findings) was determined by examining the primary results published in abstracts or, in cases where the abstract was unclear, by reviewing the full text.

The effectiveness of behavior change interventions was clustered across the three categories previously shown (Prescription Behavior, Other Behavior, Hand Hygiene), and for each category we examined the effectiveness reported by the authors. We mainly observed:

- Positive outcomes: The most common result was positive behavior change, observed in 46.3 % of the studies. This was particularly evident in prescription behavior, where 17 out of 39 studies on prescription behavior reported positive effects.
- Mixed results: A significant proportion of studies, 22.4 %, showed mixed results, indicating both positive and negative effects or inconsistent findings.
- Negative outcomes: In 17.9 % of cases, interventions had a negative or opposite effect on the target behavior.
- Incomplete data: A small percentage of studies, 7.5 %, had missing information regarding the significance of their findings, limiting the ability to draw definitive conclusions.

Regarding specific observations within mixed results cluster, for prescription behavior cluster: 7 studies reported both positive and negative effects, while 2 showed positive and not significant outcomes; for other behavior cluster: 2 studies had mixed results (positive and negative) and 2 had positive and not significant outcomes; lastly for hand hygiene behavior group: 1 study showed a positive and negative effect. For more details see Table B in appendix.

3.4. Research designs

Among the total of 67 articles, the predominant research design was quantitative, accounting for 56.8 % of the studies. This category comprised 49.3 % observational studies, 4.5 % randomized controlled trials (RCTs), and 3 % non-randomized controlled trials (Non-RCTs). Qualitative articles accounted for 17.9 % of the total. Review designs contributed to 13.4 % of all publications, including 10.4 % of systematic reviews, and 3 % of unsystematic reviews. The last category, theoretical

Table 2
Clusters & Sub-clusters of Target Behaviors

Target behavior	Sub-Target	N° - %	Total (N° - %)
Prescription Behaviors	- Antibiotics prescriptions and use - General prescription, e.g., adherence to treatment guidelines, other drugs use and prescription, treatment of diseases, follow-up tests, self-medication	28 (41.8%)	**39 (58.2%)**
	- Benzodiazepines (BZDs) prescriptions - Chronic Obstructive Pulmonary Disease (COPD) prescriptions - Opioids prescriptions - Interventions to support weight loss	8 (11.9%)	
	- Depressive Disorders prescriptions therapies - Low Back Pain (LBP) prescriptions therapies - Risk Prevention of diseases, e.g., cardiovascular diseases (CVD)	3 (4.5%)	
Other Behaviors	- Infection Prevention and Control (IPC), e.g., Catheter-Associated Urinary Tract Infections (CAUTIs), healthcare associated infections	4 (6.0%)	**21 (31.3%)**
	- Patient Care, e.g., integrating discoveries into patient care, bowel management, practices to facilitate changes in patient outcomes and experiences	3 (4.5%)	
	- Musculoskeletal Disorders, e.g., unhelpful beliefs in musculoskeletal pain and emotional response to pain, knee osteoarthritis management	6 (9.0%)	
	- Physical Inactivity, e.g., Exercise Counseling (EC) to patients, increasing physical activity - Risk Prevention, e.g., Individual risk reduction for Sudden Unexpected Death in Epilepsy (SUDEP), Cardiovascular Disease (CVD) prevention		
	- Adherence to medication, e.g., clinician guidance on assuring patient adherence to medication	5 (7.5%)	
	- Early detection of Chronic Obstructive Pulmonary Disease (COPD) - Early Oral Feeding (EOF) after colorectal surgery - Injury, e.g., develop theory-informed Knowledge Translation (KT) for Spinal Cord Injury (SCI) management - Rehabilitation, e.g., moving rehabilitation evidence into clinical practice		
	- Not assigned	3 (4.5%)	
Hand Hygiene	- Infection Prevention and Control (IPC), e.g., in case of COVID-19, surgical hand hygiene, hand hygiene compliance	**7 (10.4%)**	
Total (N° - %)		**67 (100%)**	

publications, accounted for 11.9 % of all articles. See Table 3 for more details.

3.5. Behavioral frameworks & publication outlets

In their pursuit of implementing positive change, authors have employed various behavior frameworks to examine behavior patterns and influences. These frameworks include but are not limited to: the process of Knowledge Translation (KT) [58,68] and its enhancement by integrating the Motivational Interviewing [66]; the Theoretical Domain Framework (TDF) [44,70] complemented by incorporating two additional frameworks, namely MINDSPACE [69] and the COM-B model [83]; the Education Outreach Visit [47,76], lastly, the Behavior Change Wheel (BCW) where in one scenario the framework has been boosted by using the COM-B model [35,39].

Also these frameworks were adopted: the Behavior Change Technique groupings (BCTs) [84]; Positive Deviance supported by the integration of Recognition-Primed Decision (RPD), Discovery & Action Dialogue (DAD) and Think Aloud (TA) [65]; Productive Communication [21]; the Theory of Planned Behavior (TPB) [67], in one case sustained with the Transtheoretical Model of behavior change (TTM) [80]; Academic Detailing [27]; Brief Opportunistic Interventions Behaviour Change Technique Taxonomy (BCTT) [25]; Printed Educational Materials (PEMs) and Communication AssessmenT Checklist in Health (CATCH) [64], and lastly the Serious Game [61].

Of the 67 articles included, the top contributors were BMC Health Services Research (4 articles), which is listed within the Scopus subject area of *Medicine – Health Policy*, followed by PLoS ONE (3 articles) in *Multidisciplinary*. BMC Family Practice, BMC Medical Education, the Brazilian Journal of Physical Therapy, and Antibiotics each had two articles published, making a total of eight additional publications.

Table 3
Types of studies.

Research design		N° - %	Total (N° - %)
Quantitative	Observational	33 (49.3 %)	**38 (56.8 %)**
	Experimental RCT	3 (4.5 %)	
	Experimental Non-RCT	2 (3 %)	
Qualitative			**12 (17.9 %)**
Review Design	Systematic Review	7 (10.4 %)	**9 (13.4 %)**
	Unsystematic Review	2 (3 %)	
Theoretical			**8 (11.9 %)**
Total (N° - %)			**67 (100 %)**

3.6. Countries and distribution of articles per year

Out of the total of 67 papers, 9 originated from the UK, and 5 were contributed by the USA. Australia and Canada had consecutive representation with 14 articles, consisting of 7 articles from each country. Belgium and Germany each published 4 articles, resulting in a combined total of 8 articles evenly distributed between them. China, India, Italy, and Switzerland collectively produced 12 publications, with 3 articles from each country.

France, Netherlands, Spain, and Thailand contributed 2 published papers each. Denmark, Ireland, Israel, Japan, New Zealand, Portugal, South Africa, Taiwan, Tunisia, Turkey, and Yemen had the least representation with only 1 article published from each country, totaling 11 scientific works.

During 2015, 2020, and 2021, there was a peak of published articles, respectively 10, 13, and 12, accounting for 52.2 % of all papers. The lowest point was reached in 2014 and 2017, with 6 publications, 3 for each period. Since this review was started at the beginning of 2022, according to our inclusion and exclusion criteria, only 1 article was accounted for that year.

3.7. Participants & type of guidelines

As expected, the most represented participants were medical doctors (MD), who were observed in 44.8 % of all publications, followed by a general category of healthcare providers and clinicians, both 37.3 %. Registered nurses (RN) covered 6 % of papers. Generally, we found that only 55.2 % (37 out of 67) of scientific works cited the source of the guidelines. In this case, 75.7 % of the scientific guidelines were redacted by scientific associations. International organizations such as WHO & CDC appeared in 7 papers (18.9 %), while local entities alliances in 2 cases (5.4 %).

4. Discussion

4.1. Main findings

Our systematic review provides a comprehensive overview of extant scholarship on the impact of guidelines on behavior change in healthcare. It identifies knowledge gaps that point toward future research directions. Of the 67 studies in our sample, prescription is the most frequently investigated behavior, followed by hand hygiene and a wide range of other behavioral outcomes. Whereas guidelines significantly influence behavior in the intended direction in less than half of the studies, results are mixed in more than one-fifth of the cases and significant but contrary to expectations in 17.9 % of reviewed articles. The complexity of the interventions and the variability in outcomes highlight the need for further research to understand the factors influencing behavior change and to develop more effective interventions. Similar results were observed by Nagtegaal et al., in fact most studies reported positive results (i.e. statistically significant improvements). This could be attributed to publication bias, which often leads to a reluctance to publish studies with null results [10].

In terms of research designs, most studies are based on quantitative methodologies, followed by qualitative work, literature reviews, and theoretical contributions. It is worth noting that, among quantitative studies, the vast majority are based on observational data, with randomized controlled trials accounting for <5 % of the sample. Geographically, data come from 25 countries, with the UK, Australia, Canada, and the US being the most represented. In terms of populations of interest, about 45 % of the studies in our sample specifically focus on medical doctors and some 37 % target healthcare workers generically.

A first indication that we can draw is that the guidelines do not always have the expected outcomes in terms of effectiveness for change in behavior. This finding requires future research to further investigate the antecedents, moderators and mediators of guideline effectiveness. Since significant proportion of studies, 22.4 %, showed mixed results this highlights the complexity of behavior change interventions and the need for further research.

A second finding, that points towards future research avenues, is that extant evidence disproportionately comes from studies that primarily focus on a limited number of English-speaking countries and on medical doctors. This raises external validity concerns and calls for future work that targets a greater number of countries and different types of health workers. For instance, the fact that only 6 % of the articles in our sample specifically target nurses contrasts noticeably with the vast number of health professionals in this category and their key role in ensuring the implementation of the guidelines.

4.2. Study limitations

The results of our systematic review should be interpreted in light of a series of limitations, most of which are inherent to this methodology and, therefore, common to similar studies. These refer primarily to the discretion in the choice of the search string and the criteria for inclusion in our final sample. Although we adopted the best practices to ensure consistency and rigor, some discretion remains and is irreducible. To maximize transparency and reproducibility, we adopted the well-established PRISMA framework, the gold standard for reporting in systematic reviews and meta-analyses. Related to the previous point, another possible limitation is the subjectivity in the judgment of efficacy as reported in the studies included in our analysis. Also, in this case, we had to make some judgment calls in the face of information that was not always clear and transparent. Taken as a whole, the results of our systematic analysis of the literature allow us to draw some conclusions, which must nevertheless be considered in light of the limitations just mentioned.

Lastly, it is important restate that systematic literature reviews help to get a better grasp of a specific domain of research. What is included in a review article is typically based on key words, titles, or abstracts. It is therefore a clear risk that what is incorporated in a review is an ambiguous mess, while literatures that could be relevant are excluded. The potential for improvement exists in every aspect.

5. Conclusion

The results of our systematic review suggest several reflections that may help pave the way for future research.

Firstly, some of our results may be particularly valuable because they are counterintuitive, conflicting with common beliefs or contrary to theoretical expectations based on previous research. For instance, earlier research into strategies for changing professional behavior has suggested that relatively passive methods of communicating guidelines, for example, through professional journals or printed educational material targeted to healthcare professionals, are rarely effective in changing professional behavior [9]. However, we came across examples where passive dissemination of guidelines is effective, whereas interventions that require an active engagement of professionals are not.

A second point that deserves attention concerns the advisability of guidelines that do not require uncritical adoption but are capable of empowering health professionals in their clinical practice. This seems particularly relevant in the medical profession, which combines high levels of competence and training, on the one hand, with the incompressible autonomy that characterizes medical decision-making, on the other. We acknowledge the limitations of this point. To exemplify this, clinical practice guidelines offer specific recommendations for treating individual diseases, but they do not adequately consider the unique requirements of older patients who are burdened with multiple complex illnesses. Boyd et al. effectively demonstrated this by applying relevant CPGs to a hypothetical 79-year-old patient, resulting in a prescription of 12 medications. This approach led to potential adverse interactions between drugs and diseases, along with challenges such as polypharmacy and prescribing cascade phenomenon. Consequently, it becomes essential to establish quality measures that cater to the comprehensive care of older patients with complex comorbidities, ultimately enhancing their overall well-being [86,87].

Related to the previous point, the third point of attention is context dependence. In this regard, our review suggests the importance of consistency between guidelines and the characteristics (e.g., cultural and socio-demographic) of the socio-health systems in which these guidelines must be applied. That said, future multi-site empirical research is needed to test this proposition. Based on our similar output, we support the message from Nagtegaal et al. [10] that for behavior change to be effective, it must consider three key factors: the type of tasks, the organizational aspects of the healthcare system, and the occupational contexts.

A fourth theme that deserves reflection is the conceptual relationship between guidelines and nudging techniques [88]. In this regard, our review reveals undoubted areas of overlap between guidelines and nudging. Therefore, future research on the guidelines will not be able to ignore some unresolved theoretical questions about nudging. For instance, are nudging interventions short-lived or do they have the ability to produce lasting effects and changes? Again, what is the return on investment of one euro or dollar used for interventions aimed at modifying the architecture of the choices compared to the return on investment of interventions implemented according to traditional approaches?

A fifth reflection concerns the studies on prescribing behavior and, in particular, the effect patients' "wishes and expectations have on prescribers" decisions. In this regard, a very recent experimental study shows that all other factors being equal, the propensity of hospital doctors to prescribe antibiotics can decrease in the presence of a patient's request for antibiotics [89].

The sixth point of attention concerns the marked heterogeneity of our review's methods. The time is ripe for reflection by the scientific

community about the desirability of greater systematic standardization in the study of the impact of guidelines on behavioral change in healthcare professionals. In this regard, the methodological standardization of the scholarship on the behavioral effects of the guidelines could benefit from experience gained in other fields of study in which the standardization of methods is now well established. It is crucial to highlight the challenges involved in analyzing outcomes related to behavioral change effectiveness. For future research in this area (encompassing nudges, and previously mentioned frameworks such as BCW) it is vital to adopt a clearer evaluation system. This system should use a shared taxonomy to enable more precise judgments about the measured outcomes and support further analysis. It is also crucial to publish null findings, as long as the study is methodologically sound, to ensure a more comprehensive and unbiased understanding of the research area. This approach is necessary due to the complexity of behavioral change research and the systems in which it operates.

As a final reflection, while working on our literature review, we have increasingly become convinced of the need for a change of perspective in the study, development, and use of practice guidelines in the health sector. The *unwarranted clinical variation* introduced by Wennberg in 2002 [90] should be fundamental to this shift of perspective. According to Sutherland and Levesque [91], unwarranted variation can be defined as "patient care that differs in ways that are not a direct and proportionate response to available evidence; or to the healthcare needs and informed choices of patients." In our opinion, close collaboration between different disciplines, including health, management, and behavioral sciences, is necessary for a paradigm shift that allows us to look at guidelines not as a bureaucratic tool but as a core pillar of the choice architecture that influences, for better or for worse, the decisions of health professionals and, consequently, the quality and sustainability of health services [88]. This paradigm shift seems imperative to reduce noise and mitigate unwarranted variations in clinical and management decisions in healthcare.

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CRediT authorship contribution statement

Stefano Gandolfi: Data curation, Formal analysis, Software, Writing – original draft, Writing – review & editing, Conceptualization, Methodology, Visualization. **Nicola Bellè:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Funding acquisition, Resources, Supervision, Validation, Writing – review & editing. **Sabina Nuti:** Conceptualization, Funding acquisition, Resources, Writing – original draft, Writing – review & editing.

Declaration of competing interest

Stefano Gandolfi is a Ph.D. student in Health Science, Technology and Management at the Interdisciplinary Research Center for Health Science at Sant'Anna School of Advanced Studies – Pisa, Italy. He is supported with a scholarship in digital health and telemedicine funded by TIM S.p.A.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.healthpol.2024.105191.

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