BMC Medical Ethics

https://doi.org/10.1186/s12910-025-01361-8

Article in Press

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Received: 27 June 2025

Accepted: 5 December 2025

Published online: 16 January 2026

Cite this article as: Coppini M., Arduini S., Mauceri R. *et al.* Low awareness of medication-related osteonecrosis of the jaw among dentists: a systematic review with a medical and bioethical perspective. *BMC Med Ethics* (2026). https://doi.org/10.1186/s12910-025-01361-8

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Low Awareness of Medication-related Osteonecrosis of the Jaw Among Dentists: A Systematic Review with a Medical and Bioethical Perspective

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Abstract

Introduction. Medication-related osteonecrosis of the Jaw (MRONJ) is a serious adverse drug reaction that can seriously affect the quality of life of patients if not promptly diagnosed and treated. To date, preventive measures have been the most effective strategy for reducing the incidence of MRONJ. The role of dental practitioners in managing patients treated with Bone Modifying Agents (BMAs) varies across countries, with some healthcare systems providing a more structured approach than others. This systematic review aims to investigate the knowledge and awareness of MRONJ among dentists, interpreting the findings from a medical and bioethical perspective.

Materials and Methods. The protocol for this study was designed following the PRISMA guideline and registered on PROSPERO (CRD420251015032). A systematic review search was conducted in PubMed, Scopus, Web of Science, and Cochrane Database to answer the PICo question: Are dentists well-informed and aware of the risk of MRONJ in patients receiving BMAs? Furthermore, to address potential geographic differences, a country-specific literature review was conducted to compare the level of MRONJ awareness between patients receiving BMAs and dental professionals within the same country. Studies published up to March 2025 were screened.

Results. Twenty-two studies were included in this systematic review. Among the 10,536 dentists involved, 62.8% were well-informed about MRONJ, but only 9.7% were aware of its risk factors. The most common sources of information were university education, followed by scientific journals and specific training courses or conferences. Studies performed in the same countries investigating MRONJ awareness among patients taking BMAs were analyzed. Country-based analysis revealed significant discrepancies between dentists' (68.5%) and patients' (19.5%) knowledge and awareness of MRONJ in the USA, Saudi Arabia, Bulgaria, and Brazil. Finally, a bioethical analysis of European legal frameworks on informed consent for pharmacological therapies revealed that adequately informing patients about treatment risks is both an ethical obligation and a legal duty, rooted in constitutional and legislative principles.

Conclusion. This systematic review reveals a low level of awareness despite an acceptable level of knowledge among dentists, highlighting an alarming discrepancy. Beyond knowledge of the disease, awareness of its risk factors and preventive strategies is essential for dentists to adopt a personalized and safe workflow for these patient groups. Ensuring personalized therapy requires a structured and collaborative approach based on ethical principles and shared knowledge. Strengthening interprofessional training and teamwork is essential to improving prevention and patient empowerment.

Keywords

Awareness, Knowledge, dentist, Osteonecrosis of the Jaw, Medication-related osteonecrosis of the Jaw, Bisphosphonate-Associated Osteonecrosis of the Jaw, MRONJ, ONJ, Systematic Review

1. Introduction

Medication-related osteonecrosis of the Jaw (MRONJ) has been defined as “an adverse drug reaction described as the progressive destruction and death of bone that affects the mandible and maxilla of patients exposed to the treatment with medications known to increase the risk of disease, in the absence of a previous radiation treatment” (1).

Drugs known to increase the risk of MRONJ include bone-modifying agents (BMAs) and anti-angiogenic agents (AA) treatment (2). These therapies are widely used across different patient populations, particularly in cancer and bone disease management. One of the main groups receiving high doses of BMAs (HD-BMAs) consists of cancer patients with bone metastases or multiple myeloma. Another important category includes patients suffering from osteoporosis or other non-malignant bone diseases, who receive low doses of BMAs (LD-BMAs) (3).

In addition, patients with breast or prostate cancer who do not have bone metastases but are at risk of fractures due to Cancer Treatment-Induced Bone Loss (CTIBL) may also be treated with LD-BMAs (4).

Finally, individuals diagnosed with Giant Cell Tumor of Bone (GCTB) often receive monthly HD-BMAs injections as part of their therapeutic regimen, representing a relatively new and understudied patient population exposed to these medications.

Given the widespread use of these medications in different clinical scenarios, the knowledge of the potential effects of BMAs, as well as awareness of patient category risk and local and systemic risk factors, is essential for optimizing patient care and developing appropriate preventive strategies(5).

To date, oral health preventive measures remain the most effective strategy to reduce the onset of MRONJ, if they are carried out before, during, and after the initiation of treatment with medications associated with an increased risk of MRONJ (6,7). The major goal of MRONJ prevention is to maintain and/or restore periodically the patient's state of dental-periodontal health (8); an additional aim of MRONJ prevention is appropriate counselling, through which the patient is informed of the risk of MRONJ and made aware of its possible clinical manifestations, thereby facilitating early diagnosis (8).

In this context, effective communication among healthcare providers becomes essential to implement patient awareness for preventive purposes, ensuring a clear and comprehensive understanding of pharmacological therapies and their potential risks.

A recent systematic review reported that only 19% of patients receiving BMAs were aware of the possibility of MRONJ onset, and among these, just the18.5% had been informed by the dentist (9).

The present systematic review aims to investigate the knowledge and awareness of MRONJ among dentists, and to offer an interpretation of the results from both a medical standpoint and a bioethics perspective.

2. Materials and Methods

2.1 Protocol

A systematic literature search was conducted independently by two authors (RM and MC). The protocol for this study was designed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (10). Prospectively, the protocol for this systematic review has been registered on the International prospective register of

Systematic Reviews (PROSPERO) with the following registration code: CRD420251015032.

2.2 PICo and research question

The research question was designed based on PICo items in which:

P: dentists;

I: evaluation of knowledge and/or awareness about MRONJ;

Co: worldwide.

The systematic review was based on the following research question: Are dentists well-informed and aware of the risk of MRONJ in patients receiving BMAs?

2.3 Data Sources and Search Strategy

Records were identified using different search engines (i.e., Medline/PubMed, Scopus, Web of Science) and by scanning reference lists of articles.

For the search strategy, MeSH terms and free text words were combined through Boolean operators as follows: (Bisphosphonate-Associated Osteonecrosis of the Jaw OR Medication-related Osteonecrosis of the Jaw OR BRONJ OR ONJ OR MRONJ OR ARONJ OR DRONJ) AND (Awareness OR knowledge OR Informed consent OR information OR perception OR attitude).

The research was completed in March 2025.

A selection of studies concerning the knowledge and awareness of MRONJ among dentists was performed. Dentists' knowledge was defined as the recognition of the existence and definition of MRONJ, whereas awareness was evaluated as a broader understanding encompassing the identification of risk factors, caring attitudes, and related clinical practices. Both were assessed through structured questionnaires. No standardized definition or universal threshold exists in the literature. The included studies used

heterogeneous approaches. Therefore, knowledge and awareness were summarized descriptively without applying a statistical analysis.

In addition to the primary search on dentists' knowledge and awareness, a separate literature investigation using the same search strategy was performed to identify studies assessing MRONJ awareness among patients receiving BMAs; only those conducted in the same countries as the dentists' studies were included.

2.4 Eligibility criteria

The inclusion criteria for the studies were as follows:

- Human studies;
- At least 30 dentists for each study;
- Only studies evaluating the dentists' knowledge and/or awareness of MRONJ.

Studies with fewer than 30 participants were excluded to reduce the risk of imprecise estimates and excessive heterogeneity, which could undermine the reliability of the findings (11).

2.5. Statistical Analysis

Selected studies were reviewed to detect outcomes of interest. For each study, the following data were extracted using a predesigned data extraction Excel sheet. The following data were collected:

i. Study characteristics: name of the first author, year of publication, name of the country where the study was performed, study aim.
ii. Dentist characteristics: gender, mean age, dental specialty and work experience.
iii. Interview process data: number of questions and duration of interview process.
iv. Outcomes: knowledge and/or awareness about MRONJ and the source of information.

Knowledge of MRONJ and awareness about its risk factors were assessed according to the operational definitions provided in each included study, which were generally based on structured questionnaires exploring knowledge of the condition, its clinical manifestations, and awareness of associated risk factors.

Some data were not present in all the studies included in the review. Continuous variables were summarized with mean values and standard deviations, while categorical variables were expressed as counts and percentages.

The analysis was conducted using a purely descriptive approach.

2.6. Risk of bias assessment

The quality of the included studies was assessed according to the Joanna Briggs Institute's Critical Appraisal Checklists for Analytical Cross-Sectional Studies (12). Quality assessment was performed independently by two authors (MC and SA), and disagreements, if present, were solved in a joint meeting with a third reviewer (RM). The risk of bias was assessed as “yes,” “no,” or “not applicable”. The risk of bias of individual studies was determined with the following cutoffs: low risk of bias if 70% of answers scored “yes”, moderate risk if 50 to 69% questions scored “yes”, and high risk of bias if “yes” scores were below 50% (13).

The checklist consists of eight elements: inclusion criteria, description of the study participants and context, exposure measurement, objectivity and use of standard criteria, confounding variables, handling of confounding variables, outcomes measured, and use of proper statistical analysis. In this context, the inclusion criteria were substituted by the assessment of the questionnaire items, which served as the basis for evaluation.

2.7. Country-based review

Following the systematic review, a country-based review was performed to compare dentists' knowledge and awareness with that of patients in the same geographical regions. Only studies performed in the same countries, analysing MRONJ knowledge and awareness among dentists and patients, receiving BMAs were included (9). Knowledge and awareness levels between dentists and patients were compared using descriptive statistics to identify possible gaps.

The inclusion criteria for the studies were as follows:

- Human studies
- English language
- At least 30 dentists or patients under BMAs therapy for the study
- Study evaluating the knowledge and/or awareness about MRONJ
- Studies conducted in the same countries

The research was completed in March 2025.

3. Results

3.1. Screening process and study selection

The initial search strategy identified 1177 records (PubMed=480, Scopus=340, Web of Science=357). These references were integrated into the EndNote reference software tool (Endnote X9.3.2, Clarivate Analytics). Four hundred and nineteen duplicates were removed by Endnote software, and 125 duplicates were removed by manual screening. Then, the screened process of 633 studies was performed based on the title and abstract, and 608 records were excluded. Subsequently, a full text evaluation of 25 studies was carried out. Finally, 3 records were excluded, and 22 papers were included in the current review. A detailed flow chart of the selection process is provided in Figure 1.

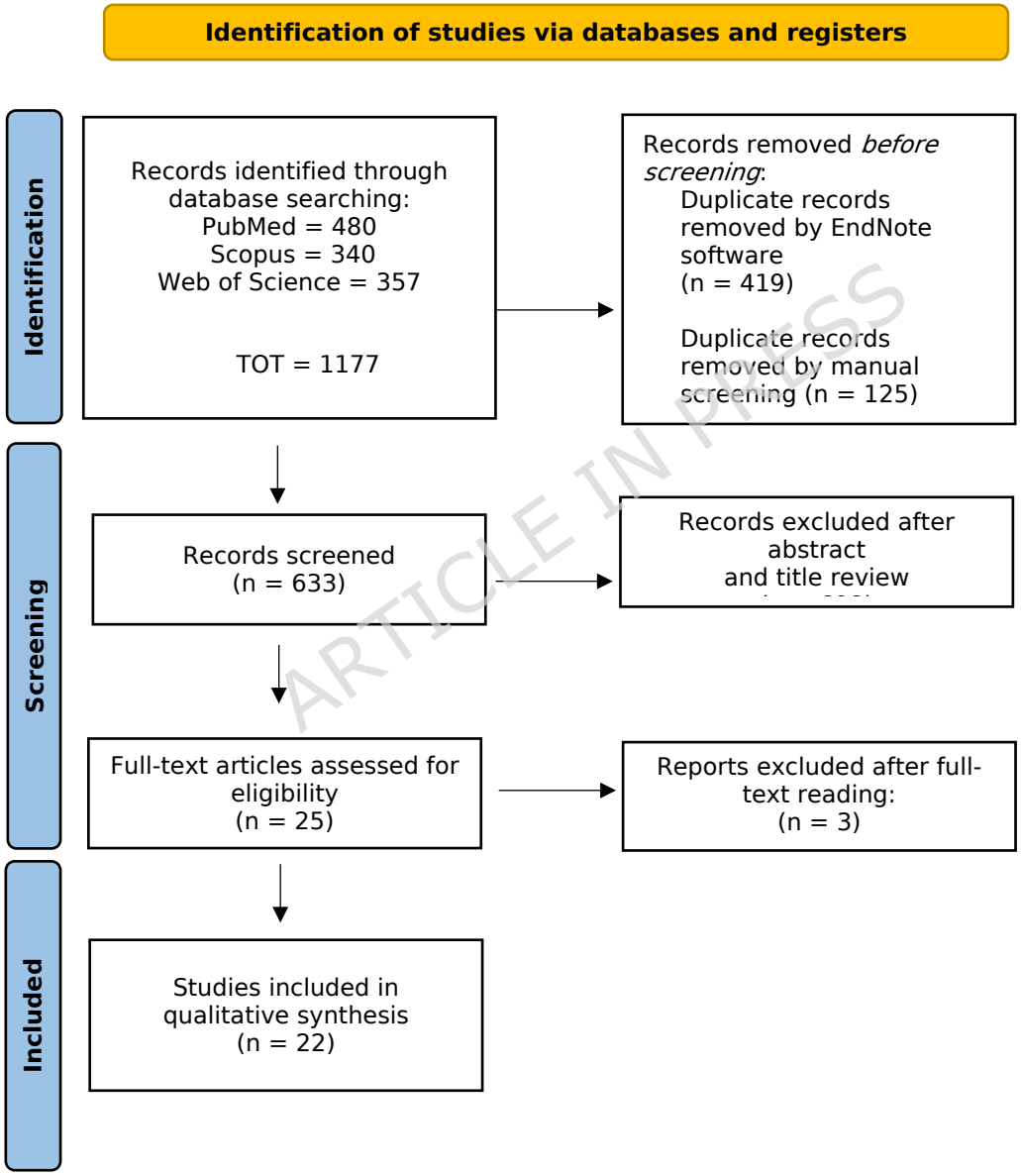

Figure 1. PRISMA Flowchart.

3.2. Characteristics of the included studies

The main characteristics of the included studies are reported in Table 1. Twenty-two studies were included in this review. The studies were published between 2010 and 2024.

Five studies were performed in Saudi Arabia (14–18), two in Brazil (19,20), two in India (21,22), two in Korea (23,24), two in Turkey (25,26), one in Bulgaria (27), one in Canada (28), one in Croatia (29), one in Iraq (30), one in Italy (31), one in Japan (32), one in Japan (32), one in Mexico (33), one in Spain (34) and one in USA (35).

Among the 10536 dentists evaluated, 3670 were general dentists (3670/10536, 34.8%), 783 oral surgeons (783/10536, 7.4%), 714 oral surgeons and periodontists (714/10536, 6.8%), 135 prosthodontists (135/10536, 1.3%), 165 orthodontics (165/10536, 1.6%), 107 periodontists (107/10536, 1%), 98 endodontics (98/10536, 0.9%), 82 paediatric dentistry (82/10536, 0.8%), 21 restorative dentistry (21/10536, 0.2%),18 oral medicine specialists (18/10536, 0.2%) and 862 were defined by some authors as “others” (862/10536, 8.2%).

In some studies, the dentist’s specialty was not specified (3881/10536, 36.8%) (15,16,18,19,23,24,32).

Based on available data, dentists’ age ranges from 23 to 60 years.

Not all studies reported the dentists' gender; however, a predominance of males over females was observed (4129 vs 2451).

A few studies reported the average clinical experience of participating dentists, which ranged from 7 to 25.2 years (specifically, 7, 8.9, 15, and 25.2 years) (27,29,30,34).

Based on the available data across multiple studies, clinical experience among dentists varied substantially. A total of approximately 1558 dentists had less than 10 years of clinical experience, while around 1149 had more than 10 years of experience. Notably, 521 dentists had over 21 years of experience in one study. The study also included 40 participants with less than 1 year of experience and 337 with 1–20 years. These findings reflect a broad and heterogeneous distribution of clinical experience among included dentists, ranging from newly graduated professionals to highly experienced clinicians with decades of practice (15,17,21–23,25,26,28).

All included studies analysed knowledge and awareness of MRONJ among dentists.

Regarding MRONJ knowledge, 6622 out of 10536 dentists were well-informed (62.8%), whereas only 1020 of them were aware of the associated risk factors (9.7%).

Concerning the source of information, most dentists stated that they were informed on MRONJ due to their university education, including dental school, residency program, and PhD/postgraduate training (777/6622, 11.7%). The other sources of information reported were scientific journals (850/6622, 12.9%), followed by specific training courses or conferences (409/6622, 6.2%), internet (294/6622, 4.4%), books and newspapers (18/6622, 0.3%).

3.3. Risk of bias

The risk of bias assessment is reported in Table 2. Of the 22 studies included, 21 were cross-sectional and assessed with the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies. The single study with a different design was not appraised for risk of bias (31).

Nine studies were considered to have a low risk of bias (15,17,18,20–22,25,28,35), ten a moderate risk (14,16,19,26,27,29,30,32–34), and the remaining two studies were classified as high risk of bias (23,24).

Most studies clearly described the study participants and setting in detail. However, only a limited number reported the validity and reliability of the questionnaire (15,17,18,20–22,25,28,34,35), whereas for the remaining studies, this aspect was unclear. Confounding factors were identified in several studies (14–22,25–30,32,33,35), but strategies to deal with them were less frequently reported (14–22,25–30,32,35). Appropriate statistical analyses were applied across all studies, mainly descriptive and inferential tests consistent with the observational design.

3.4. Country-based review

Building on our previous systematic review of MRONJ awareness among patients, we performed a supplementary literature review focusing on country-specific differences (9). Studies published in the USA, Saudi Arabia, Bulgaria, and Brazil investigating the knowledge and/or awareness of MRONJ among dentists and patients taking BMAs were included (14–20,27,35–39). Among these, 9 studies assessed dentists' knowledge and awareness, while 4 evaluated that among patients taking BMAs. In total, 4496 dentists and 318 patients under BMAs were assessed. This country-based literature review revealed that 3078 dentists and only 62 patients were well-informed on the possibility of MRONJ onset (68.5% and 19.5%, respectively). More specifically, in the USA, 68% of dentists and 18% of patients were aware of MRONJ risk (35,39); in Brazil, 89.2% of dentists and 9.2% of patients (19,20,36); in Bulgaria, 82.7% of dentists and 17.9% of patients (27,37); and in Saudi Arabia, 56.3% of dentists and 33.8% of patients were aware (14–18,38).

4. Discussion

Medication-related osteonecrosis of the jaw is a drug adverse reaction that can significantly worsen the quality of life in patients who already have multiple comorbidities.

To the best of our knowledge, very few studies have investigated dentists' knowledge and awareness of MRONJ, and, to date, this is the first systematic review on the topic.

From our literature search emerges a lack of awareness among dentists, despite their acceptable knowledge of the disease. Even more critically, as the review suggests, although dentists know the condition, they do not consistently adjust their clinical practice or modify their usual approach. For this reason, the present study focused primarily on assessing dentists' awareness.

Another issue that emerged from the literature is their inadequate communication with patients, which further reflects this limited awareness.

Indeed, although the present study indicates that 62.8% of dentists are well-informed on MRONJ, a recently published systematic review revealed that only 19% of patients taking BMAs were aware of the possibility of MRONJ onset, and among these, just the18.5% had been informed by the dentist (9).

This discrepancy could be attributed to the fact that the responsibility of informing patients about the risks associated with drug therapies does not fall solely on the dentist. Patients at risk of MRONJ are generally managed by a multidisciplinary team comprising the prescribing physician (e.g., bone experts, oncologist), oral health care specialists, and pharmacist (9,40–42). It is therefore possible that communication breakdowns within the team, or assumptions about who is responsible for patient education, may lead to patients not receiving adequate information.

The marked discrepancy between the proportion of dentists who declared knowledge of MRONJ (62.8%) and those recognizing its risk factors (9.7%) suggests a superficial or partial understanding of the disease. Disease awareness presupposes an adequate knowledge of the condition, including its risk factors. Such limited awareness may undermine effective prevention, early diagnosis, and the ability of dentists to provide adequate patient education, highlighting the urgent need for targeted training programs.

The involvement of multiple professionals often leads to a proliferation of information sources, which may ultimately compromise patient comprehension and awareness (43). While each professional is ethically obligated to provide relevant information, a compartmentalized understanding of this duty may hinder patients from achieving a clear and comprehensive understanding of pharmacological therapies and their associated risks.

Variations in the countries where the different studies were conducted may reflect differences in guidelines, national policies, and the standard protocols for patient counselling regarding the need for a dental

evaluation before or during BMA therapy (as, for example, established in Italy by our Diagnostic-Therapeutic Care Pathway (PDTA) for MRONJ, no. 11/2024, approved on August 16, 2024, by the University Hospital "Paolo Giaccone" in Palermo) (44).

In the Italian legal framework, it is explicitly recognized that informed consent is not merely a formal requirement but an essential expression of the patient's fundamental right to therapeutic self-determination. This right is legally distinct and autonomous from the right to health and – as the Italian Supreme Court clarified – the omission of adequate information by the physician can infringe upon both rights independently, each potentially giving rise to medical liability and compensable harm (Cass. civ., sez. III, 5 September 2022, n. 26104).

Italian Law No. 219/2017 explicitly states that informed consent must be understood not as a one-time event, but as part of a broader and dynamic relational process grounded in trust, communication, and personalization of care (45). In detail, Article 1 affirms the patient's right to receive complete, updated, and comprehensible information regarding the diagnosis, prognosis, benefits and risks of diagnostic and therapeutic procedures, available alternatives, and the consequences of refusing treatment.

In some healthcare systems, the role of dental professionals in the care pathway of patients taking BMAs is more structured and emphasized, while in others, it remains limited or poorly integrated. To mitigate this potential bias, we conducted a further country-based literature review. The emerging findings underscore an alarming discrepancy between dentists' and patients' awareness about MRONJ.

In the USA, 68% of dentists and 18% of patients were well-informed on the MRONJ risk (35,39). This relatively wide gap in awareness may be linked to the legal tradition of informed consent, which is rooted in case law and emphasizes disclosure of material risks from the perspective of a reasonable patient. While legally robust, this system is often litigation-

driven and may prioritize liability protection over relational communication (46).

In Brazil, 89.2% of dentists and 9.2% of patients reported MRONJ awareness (19,20,36). Although the Brazilian Constitution and the Medical Ethics Code formally affirm autonomy and the right to informed decision-making, the uneven implementation across the healthcare system may explain the discrepancy between dentists' and patients' knowledge (47).

In Bulgaria, 82.7% of dentists and 17.9% of patients were well-informed of MRONJ (27,37). Here, the Health Act mandates written informed consent, focusing primarily on formal documentation. This legal framework, while ensuring standardized procedures, may limit the extent of interactive dialogue necessary to improve patient understanding (48).

In Saudi Arabia, 56.3% of dentists and 33.8% of patients reported MRONJ awareness (14,38). Informed consent in this context is required both ethically and religiously; however, cultural norms, particularly concerning women and minors, can influence how autonomy is exercised in practice, potentially affecting patient–clinician communication and awareness levels (49).

Overall, these country-level differences suggest that variability in MRONJ awareness and knowledge is not solely a matter of professional or patient education but is also shaped by distinct legal frameworks, cultural expectations, and systemic approaches to informed consent.

Looked at comparatively, these frameworks reveal that informed consent is consensually understood and proposed not as a bureaucratic formality, but as a process with ethical, relational, and professional depth. While legislative frameworks differ in scope and emphasis, the shared direction points toward recognizing the patient as an active, autonomous agent in care decisions. For this reason, it is essential that professional communities, particularly dentists, actively reflect on these principles and develop the skills necessary to put them into practice.

According to the law, the principle of informed consent applies not only to treatments but also to diagnostic procedures. This aligns with established doctrinal orientations, which – when addressing the meaning of "healthcare treatment" under Article 32 of the Italian Constitution – have consistently included within its scope all diagnostic and therapeutic activities aimed at preventing or curing disease in the broadest and most general sense possible, regardless of whether they are instantaneous or prolonged in duration.

Therefore, no distinction based on the presumed severity of the intervention – whether a long-term therapy or a one-time measure (such as a vaccination), a surgical operation or a pharmacological treatment – can exclude any of these categories from the definition of healthcare treatment (50). Accordingly, informed consent obligations fully apply to drug administration, especially when associated with significant risks.

Within this normative context, ensuring that patients are adequately informed about such risks is not only an ethical imperative but also a legal duty grounded in constitutional principles and legislative provisions.

In this regard, the authors present a workflow (Figure 2) that visually emphasizes how informed consent is not merely a signed form, but rather the outcome of a virtuous process involving education, harmonized communication, monitoring, and continuous support, reflecting the shared ethical commitment of all professionals to the patient's well-being.

As can be observed in the workflow, in MRONJ prevention, each figure plays an active role (51):

- The bone expert prescribing BMA therapy has the responsibility to prescribe and monitor the treatment and refer the patient to both a dentist and a pharmacist. Additionally, the clinician must instruct the patient, ensuring they are fully aware of the risk of developing MRONJ and the associated risk factors, regardless of the preventive dental measures that may have been planned or carried out before and/or during the treatment;

- The pharmacist plays a key role in patient care by checking for potential drug interactions, providing additional risk disclosures, and offering clear, relevant information to help the patient safely manage their therapy;
- The dentist is responsible for planning and carrying out all primary and secondary preventive measures aimed at reducing the risk of MRONJ and ensuring its early diagnosis. A key part of this role includes raising patient awareness about the possible clinical signs and symptoms of MRONJ;
- The patient, once properly informed, is responsible for adhering to the recommended prevention and monitoring program. This cooperation allows the healthcare professionals involved in their care to effectively control risk factors, maintain oral health, and ensure the early diagnosis of MRONJ.

Moreover, it is essential to emphasize that this workflow is not unidirectional but cyclical, as the relationship between the prescribing physician and the dentist is constantly bidirectional.

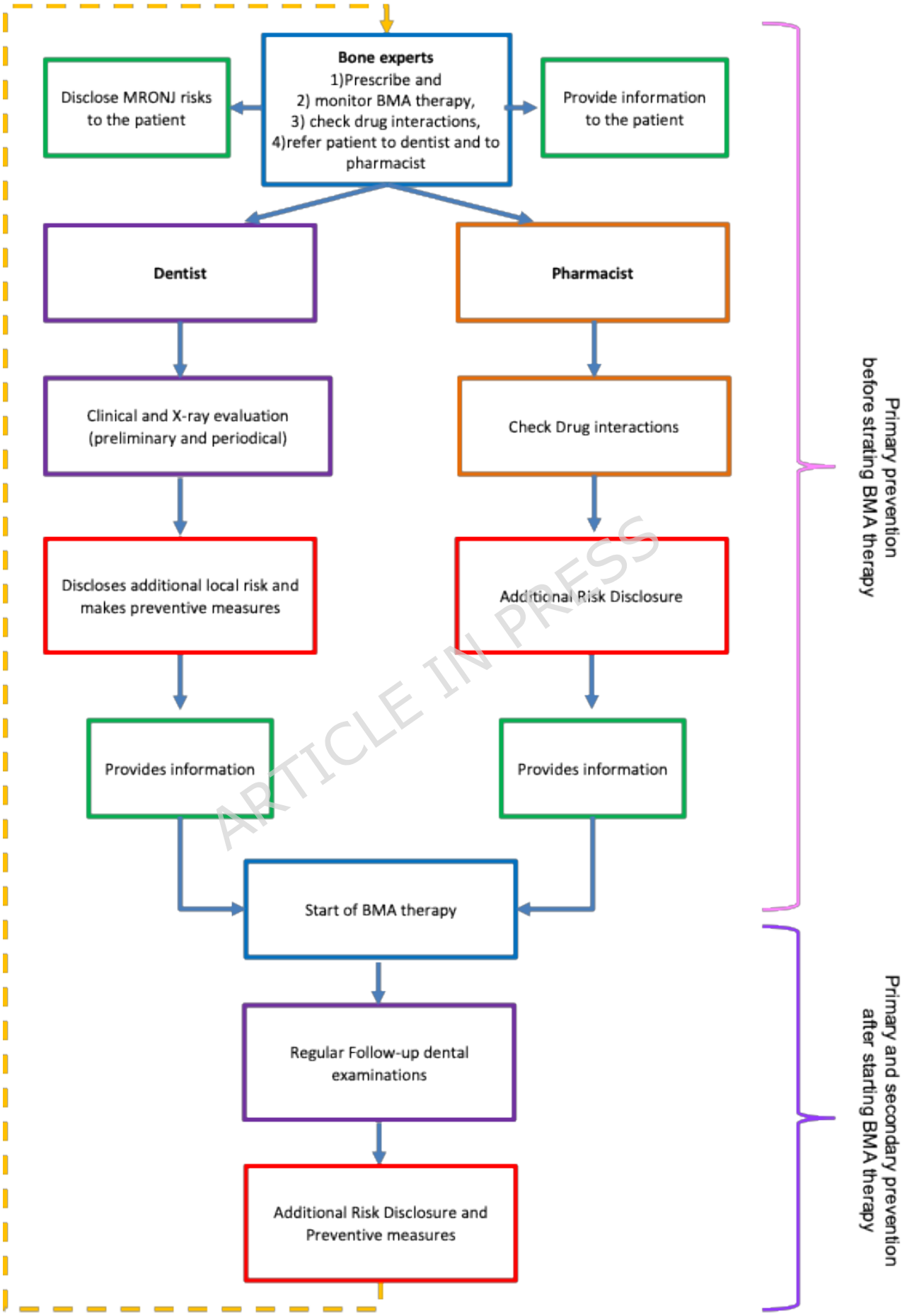

Figure 2. The flowchart of information process in MRONJ prevention: a shared ethical process beyond the signature.

In the specific case of MRONJ, the lack of coordination and communication between physicians and dentists can negatively impact the prevention or mitigation of adverse reactions. Therefore, all healthcare providers – physicians, dentists, and pharmacists – should engage in open and proactive dialogue to promote coordinated care (52).

This proactive approach ensures patients' right to be informed and allows for a more transparent discussion of therapeutic risks. Awareness begins with the basic knowledge of drug effects, but more importantly, with a perceiving attention to the clinical situation of the patient, for a better understanding of her needs. This caring attention is the ground for establishing a dialogue with other professionals(53,54). Barriers to effective interprofessional communication between dental practitioners and general practitioners can have significant implications for patient safety. Poor communication and the lack of coordination between healthcare providers can compromise patient well-being. In this sense, some of the obstacles to efficient collaboration are time constraints, difficulty in contacting colleagues, and scheduling incompatibilities. Additional challenges include the lack of interprofessional knowledge and insufficient training on collaborative practices during undergraduate education (55).

From an ethical standpoint, understanding care as a collective practice can help overcome an overly individualistic perspective and the prevalence of a fragmented view of liability, replacing them with the idea of collaborative engagement in delivering patient treatment (56).

Interprofessional care has ethical roots, as it is primarily justified a shared commitment to promoting patient wellbeing. Healthcare professions share a set of principles – the core being represented by patients' wellbeing – which provide a common basis to be adapted to the peculiarities of each discipline.

Collaboration between healthcare providers should be considered as a shared action aimed at a common goal. This viewpoint helps to clarify the ethical foundation of collaborative healthcare, its implications, and the skills needed. In this regard, the perspective of virtue ethics can offer a moral framework for interprofessional collaboration, helping with the understanding of the relational and character-based nature of team-based care. This ethical approach emphasizes moral character traits rather than abstract principles or outcomes. Even if the definition of virtue is controversial – and sometimes emphasized as a character trait or as a skill – in the field of professional virtue ethics the concept of virtue indicates how to fulfil a profession's aim excellently, building a good perceiving attitude (57). In fact, the duty of care can be performed in better and worse ways. To offer good care for the patient's well-being, professionals must perform with the correct attention to her needs and with the willingness to take responsibility for those needs (58).

Therefore, virtues are not only a way of pursuing the flourishing of professionals but, above all, a means of fulfilling the profession's aim, and its advance as an increasing ability to improve professionals' abilities.

In any case, virtue ethics can be applied to the specific context of professional roles, providing a valuable explanation of their nature and moral significance. From this perspective, a good professional contributes to the aims of the profession, which – if the profession itself is to be considered good – must ultimately be directed toward the promotion of a fulfilling human life (59).

This approach should then illustrate how the proper goals of medicine will shape the character and actions of a good health professional, and consequently, should provide an explanation of the virtues that are appropriate for healthcare practice. In this sense, the moral traits to be cultivated include trustworthiness, honesty and humility – as opposed to arrogance and distrust – but also fairness, open-mindedness, the capacity for team-working and the ability to listen and appreciate differences (59,60).

The teleological perspective of virtue ethics in healthcare highlights that the intrinsic aims of medicine must guide the ethical conduct of professionals. In this sense, a shared ethical horizon encourages interprofessional collaboration, improving both care quality and patient-provider relationships. To overcome a fragmented view, it is therefore essential to shift from a model based on isolated professional roles and responsibilities toward one that embraces a shared commitment to the patient's wellbeing, starting from effective communication between healthcare providers (61).

Beyond professional and ethical aspects, patient-centred factors may also influence MRONJ awareness (62). Cultural influences, including attitudes toward medical authority and family involvement in decision-making, may further shape how information is received and interpreted. Moreover, some patients may receive information about MRONJ but later forget or overlook it, particularly when undergoing complex therapies and dealing with distressing health concerns. Such circumstances, together with information overload, can reduce retention and awareness. Addressing these barriers through clear, repeated, and tailored communication strategies is essential to ensure patient understanding and support shared decision-making (63).

In addition to targeted training on MRONJ aimed at enhancing dentists' awareness, stressing the importance of preventive workflow and personalized approach based on interprofessional communication and collaborative care can significantly enhance patient awareness, thus reducing the discrepancy highlighted in this literature review. Education in interprofessional ethics can play a fundamental role in this process by fostering a shared ethical framework, promoting mutual understanding, and developing the communicative competencies essential to effective teamwork in healthcare settings. It equips professionals across different disciplines – medicine, nursing, pharmacy, dentistry, and beyond – with a common ethical vocabulary that facilitates dialogue and stresses the importance of providing patients with a complete set of information because of a collaborative approach. It is, therefore, crucial to promote

the integration of interprofessional education – conveying both scientific and ethical knowledge – into undergraduate and postgraduate curricula (64), while also emphasizing the need for institutional efforts to encourage a cultural shift toward multidisciplinary, collaborative, and patient-centered care (55). This cultural shift must be pursued since the university curricula with the promotion of activities in which not only students of different disciplines but also students among different curricula – doctors, dentists, nurses – interact and learn to work together.

This review has some limitations due to the heterogeneity of the included studies.

A major limitation is the heterogeneity of survey questions across studies, which limits the direct comparability of dentists' knowledge and awareness. Moreover, not all studies specified the dentists' specialization or their work experience. Educational systems and legal guidelines vary from country to country, which may partly influence the level of knowledge and awareness of dentists and their relationship with patients, limiting the generalizability of the results. For this reason, to address this potential bias, we carried out an additional country-specific literature review.

A limitation of the country-based review is that data were available only from a restricted number of countries (i.e., USA, Saudi Arabia, Bulgaria, and Brazil), and patient samples were substantially smaller than dentist samples. This imbalance limited the robustness of direct comparisons and, therefore, only descriptive analyses were performed.

Another limitation is the lack of a temporal stratification of the included studies; however, most were published after 2020, when the majority of MRONJ guidelines were already available(65–67).

In summary, ensuring informed consent in high-risk treatments such as those associated with MRONJ requires a structured and collaborative approach among healthcare professionals to guarantee patient comprehension and autonomy.

The process should begin with adequate training and awareness, where physicians, dentists, and pharmacists must be educated on MRONJ risks, prevention strategies, and effective communication techniques (66). Interprofessional education plays a crucial role in fostering collaboration and reinforcing ethical responsibility across disciplines.

The physician who prescribes the drug therapy must disclose its potential risks to the patient, providing both written information and clear verbal explanations. Before starting the treatment, the patient should undergo an oral evaluation and, in this context, the dentist should reinforce the physician’s risk disclosure, indicate preventive measures, and ensure that the patient understands the importance of monitoring oral health. Pharmacists should support this process by reviewing medications, identifying potential interactions, and offering additional counselling on adherence and oral care. Regular follow-ups and ongoing coordination among healthcare providers are essential to maintain consistent communication and monitor the patient’s condition over time.

By addressing common barriers such as lack of awareness and poor interprofessional communication, this collaborative model ensures that patients receive transparent, comprehensive, and patient-centered care. Ultimately, this approach minimizes MRONJ risks while empowering patients to make fully informed decisions about their treatment.

Conclusion

This systematic review highlights a critical gap between dentists' awareness and their knowledge of MRONJ. While the overall level of knowledge appears acceptable, it is concerning that dentists are aware of the condition yet do not consistently translate this knowledge into appropriate clinical actions. This emphasizes the urgent need for a structured workflow and a substantial change in dentists' *modus operandi* to ensure that awareness is effectively converted into preventive practice. Strengthening communication and collaboration among healthcare professionals remains essential for bridging this gap, as does enhancing

patients' understanding of the associated risks. Ensuring truly informed consent requires a coordinated, interprofessional framework grounded in ethical responsibility, shared competencies, and patient-centered care. Promoting interprofessional education and fostering a collaborative culture are essential steps toward empowering dentists and patients, and reducing the incidence of MRONJ through prevention, transparency, and ongoing support. Future research should focus on developing and evaluating both monoprofessional and interprofessional operational programs, as well as targeted communication strategies, to effectively close the awareness and knowledge gap.

Author Contributions: Conceptualization GC, RM and IATP; methodology, MC, RM, SA; validation, GC, RM and IATP; formal analysis, MC and SA; investigation, MC, SA and RM; resources, MC, SA and RM; data curation GC, IATP, RM; writing—original draft preparation, SA and MC; writing—review and editing, GC, RM and IATP; visualization, GC, RM, IATP, MC and SA.; supervision, GC, RM and IATP.; project administration, IATP and RM; funding acquisition, GC, RM and IATP.

All authors have read and agreed to the published version of the manuscript.

Funding: This research has been funded by the PJ_UTILE_2022_VQR_Misura_B_D17 and by Progetto GENESIS-ATI, codice T3-AN-11 - codice U-GOV PRJ-0692, finanziato dal Ministero della Salute (MC).

PROSPERO registration code: CRD420251015032.

Data Availability Statement: All data generated or analyzed during this study are included in this published article.

Acknowledgments: None.

Conflicts of Interest: The authors declare no conflict of interest.

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First Author	Year	Country	Sample Size	Dentist Speciality	Mean age (years)	Male/Female	Awareness about MRONJ	Source of information
López-Jornet P	2010	Spain	60	General Dentist	32.8 ± 1.7 (23–58)	36/24	41 (68.36%)	Internet (58.3%); scientific journal (60%); training course (71.7%)
Yoo JY	2010	Korea	264	n.d.	n.d.	n.d.	149 (56.5%)	Scientific journals (41.4%); conferences (41.4%)
Alhussain A	2014	Canada	1579	Oral surgeons (57); Periodontists (42); Prosthodontists (20); Endodontists (26); General practitioners (1003); Other (16)	25-34: 131; 35-44: 233; 45-54: 297; 55-64: 271; >65: 86	n.d.	947 (60%)	n.d.
Gonzales CB	2015	USA	93	General Dentist (69%); Dental Surgeon (25%); Non surgical speciality (6%)	n.d.	n.d.	63 (68%)	n.d.
Vinitzky-Brener I	2017	Mexico	410	General Dentist (249); Orthodontists (67); Prosthodontists (22); Pediatric dentistry (18); Endodontists (14); Maxillofacial surgery (13); Periodontists (9); Oral Medicine (4); Others (10)	n.d.	n.d.	1 (0,3%)	n.d.

Al-Samman AA	2019	Iraq	113	General dental practitioners	30.4	52/ 61	38 (33.6%)	n.d.
Hristamyan -Cilev MA	2019	Bulgaria	323	General Dentistry (63); Oral Surgery (35); Prosthodontics (23)	40	n.d.	267 (82.7%)	dental journal (64.71%); Internet (55.11%)
Al-Eid R	2020	Saudi Arabia	74	General Dentist (47); Endodontists (4); Oral medicine (2); Radiologist (2); Orthodontists (3); Pedodontists (3); Periodontists (4); Prosthodontists (5); Restorative (4)	n.d.	n.d.	45 (60.8%)	Internet (10.9%); Newspaper (2.2%); Journals (26.1%); Books (32.6%); Seminars (87%); Others (3, 6.5%)
Al-Maweri SA	2020	Saudi Arabia	607	General Dentist (305); Specialists (302)	<30: 298; 30-39: 219; >40: 90	403/204	425 (70%)	Dental school/residency program (49.8%); Internet (10%); Scientific Meeting (6.1%); Journal articles (7.7%); Education courses (3.5%)
Alqhtani NR	2020	Saudi Arabia	207	n.d.	25-30: 172; 30-35: 23; 35-40: 4; >40: 8	115/92	83 (40%)	n.d.
Miranda-Silva W	2020	Brazil	1032	n.d.	n.d.	n.d.	965 (93.5%)	n.d.
Patil V	2020	India	234	Oral Medicine (7); Oral Surgery (15); Periodontology (19);	n.d.	65/168	195 (83.3%)	n.d.

				Endodontics (10); Prosthodontics (7)				
Ekmekcioglu A	2021	Turkey	141	No speciality (105); Oral and Max. Radiology (5); Oral and Max. Surgery (6); Restorative Dentistry (5); Endodontics (2); Orthodontics (1); Pediatric Dentistry (10); Periodontology (2); Prosthodontics (5)	24-34: 52; 35-44: 63; >45: 26	51/ 90	81 (57.4%)	University education (33.3%); PhD/postgraduate (20.1%); Journals (29.6%); Congress/Seminar (7.4%); Internet/Television (19.7%); Patient anamnesis (3.7%); Drug experiences (3.7%)
Özkan E	2021	Turkey	620	General Dentists (356); Orthodontics (72); Oral surgery (44); Pedodontics (39); Prosthodontics (30); Periodontology (21); Endodontics (24); Oral radiology (12); Restorative dentistry (12).	23-33: 356; >33: 255	311/ 288	431 (69.5%)	Patient (7%); Colleague (8.3%); Scientific articles (9.4%); Congress (10.7%); undergraduate education (30.5%)
Han AL	2021	Korea	1000	n.d.	41-50	787 / 232	650 (65%)	n.d.
Yamori M	2021	Japan	307	n.d.	n.d.	n.d.	153 (50%)	Japan position paper
Bival S	2023	Croatia	458	General Dentists (329); Oral Surgery (37); Prosthodontics (23); Pedodontics (12);	41.33	215/233	290 (63.3%)	n.d.

				Oral medicine (5); Endodontics (18); Periodontics (10); Orthodontics (22)				
Nassani MZ	2023	Saudi Arabia	1685	General dentists (610); Oral Surgery (263); Other dental speciality (812)	< 30: 571; 31-50: 940; >50: 174	57.7% / 42.3%	852 (50.6%)	n.d.
Costa Wanderley Rocha FG	2023	Brazil	339	Oral Surgery	20-25 yrs: 37; 26-30 yrs: 80; 36-40: 55; 41-45: 47; 46-51: 26; 55-60: 8; > 60: 1	80 /259	258 (76.1%)	n.d.
Shapurwala MA	2024	India	403	Oral surgeons (213)	n.d.	n.d.	342 (85%)	Journals (29%); undergraduate program (22%); postgraduate training (19.8%)
Alghofaili MM	2024	Saudi Arabia	136	n.d.	n.d.	n.d.	119 (87.5%)	University (71.3%); Mass media (1.5%); Scientific Journals (10.3%); Medical meetings (5.1%)
Landi L	2024	Italy	451	Periodontology and Implantology	54 (42–60)	364/ 87	225 (49.9%)	International guidelines (51.4%); Conferences (19.5%); Scientific literature (12.2%);

								Documents proposed by CAO, FNOMCEO or other organization (11.8%); Other (5.1%)

Table 1. Characteristics of included studies.

Study	1. Were the survey items clearly defined?	2. Were the study subjects and the setting described in detail?	3. Was the exposure measured in a valid and reliable way?	4. Were objective, standard criteria used for measurement the condition?	5. Were confounding factors identified?	6. Were strategies to deal with confounding factors stated?	7. Were the outcomes measured in a valid and reliable way?	8. Was appropriate statistical analysis used?	Quality Score
López-Jornet et al.	Yes	Yes	Yes	Not applicable	No	No	Yes	Yes	5
Yoo et al.	Yes	Yes	Unclear	Not applicable	No	No	Unclear	Yes	3
Alhussain et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Gonzales et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Vinitzky-Brener et al.	Yes	Yes	Unclear	Not applicable	Yes	No	Yes	Yes	5
Al-Samman et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6
Hristamyan-Cilev et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6
Al-Eid et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6
Al-Maweri et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Alqhtani et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6

Miranda-Silva et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6
Patil et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Ekmekcioglu et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Özkan et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6
Han et al.	Yes	Yes	Unclear	Not applicable	No	No	Unclear	Yes	3
Yamori et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6
Bival et al.	Yes	Yes	Unclear	Not applicable	Yes	Yes	Yes	Yes	6
Nassani et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Costa Wanderley Rocha et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Shapurwala et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7
Alghofaili et al.	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes	7

Table 2. Risk of bias of included studies.