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Closing the Evidence-Practice Gap in Implant Treatment through Health Information Systems*

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Abstract

Health information systems are increasingly proposed as a means of carrying clinical evidence to the point of care, yet their role in implant treatment has rarely been examined in these terms. Implant treatment has matured into a predictable form of oral rehabilitation, supported by high survival rates and by a rapidly expanding set of digital planning, diagnostic, and documentation tools, but the pace of technological innovation has outstripped its consistent translation into routine care, leaving a persistent distance between the available clinical evidence and everyday practice. This narrative review reframes that distance as an information management problem and examines the extent to which health information systems may operate as translation mechanisms between evidence and the point of care. Drawing on a structured Scopus search of literature published between 2015 and 2025, the review organises the relevant work along three information-system dimensions: clinical decision support and decision-making, registries and electronic health records, and patient-facing information. The synthesis indicates that the gap reflects the limited translation of evidence into workflow-embedded, point-of-care formats, compounded by the fact that many digital products reach the market with little or no clinical documentation. Health information systems emerge as a plausible lever whose effectiveness is not yet conclusively demonstrated, with adoption shaped by usability, workflow fit, interoperability, data quality, and clinician trust in system-generated recommendations. A research agenda is proposed for evaluating these systems as translation mechanisms and not as isolated technical artefacts.

Keywords: implant treatment; evidence-based practice; evidence-to-practice gap; health information systems; clinical decision support

Introduction

Implant-supported restoration is a well-accepted option for rehabilitating partially and completely edentulous patients. Long-term retrospective work on implant fixed complete dental prostheses reports favourable survival of both implants and prostheses over several years (Chochlidakis et al., 2020; Chochlidakis et al., 2022), and comparative analyses of full-arch rehabilitation in large controlled cohorts confirm predictable outcomes across differing implant configurations (Caramês et al., 2025). In parallel, the discipline has absorbed a continuous stream of digital innovation, from three-dimensional planning and guided workflows (Bianchi et al., 2022) to indication-specific imaging protocols and structured radiographic recommendations (Fontenele et al., 2025). The clinician operates in an environment at once evidence-rich and technology-dense.This abundance has not, however, guaranteed that the best available evidence reaches the chairside in a usable form. Jokstad (2017), in a systematic appraisal of computer-assisted technologies used in oral rehabilitation, found that the great majority of

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commercially available digital products carried no clinical documentation at all, and cautioned that clinicians should request clinically meaningful information about new products before accepting technological description alone. The difficulty identified there lies in the weak translation of innovation into validated, decision-relevant knowledge, since the supply of innovation itself is not in question. A comparable pattern recurs across treatment planning, where decisions of considerable consequence are still made with substantial interpractitioner variation (Gönüldaş et al., 2025; Al Shaltoni et al., 2025).

The distance between what the evidence supports and what is routinely practised is commonly described as the evidence-to-practice gap. In implant dentistry this gap is frequently framed as a clinical or educational matter. The present review advances a different framing. It treats the gap as an information management problem, on the premise that evidence influences care only when it is accessible, structured, and embedded within the systems through which clinicians plan, document, and review treatment. The pertinent question then becomes whether the information systems surrounding implant treatment are configured to carry existing evidence to the point of decision.

This contribution examines that question through a narrative review of recent literature. It establishes a conceptual framing and method, characterises the evidence-to-practice gap as it manifests in implant treatment, and then considers three categories of health information system as candidate translation mechanisms: clinical decision support, registries and electronic health records, and patient-facing information. The aim is not to catalogue every digital tool, but to position the gap at the intersection of clinical practice and health information systems and to outline where evaluative research is most needed.

Conceptual Framing

The evidence-to-practice gap denotes the recurring finding that research knowledge, including knowledge consolidated in guidelines and systematic reviews, is applied inconsistently in routine clinical settings. It is among the most consistent observations in health services research. Grol and Grimshaw (2003) estimated that a substantial proportion of patients do not receive care consistent with current evidence, while a further proportion receive care that is unnecessary or potentially harmful. Cabana et al. (1999) organised the reasons clinicians depart from available guidance into recognisable categories, including limited awareness or familiarity, disagreement with the recommendation, low self-efficacy, and external constraints on practice. In implant treatment the gap is multifactorial, reflecting the strength and accessibility of the evidence, the way it is represented at the moment of decision, and the structural conditions of practice. Each factor is, in part, an information problem, depending on how knowledge is captured, formatted, and surfaced.

Health information systems are understood here as the digital infrastructures through which clinical information is recorded, processed, and made available for use. The category is deliberately broad. It encompasses clinical decision support systems that present structured recommendations during planning, registries and electronic health records that accumulate longitudinal outcome data, and patient-facing resources that mediate what patients understand about their own treatment. Sutton et al. (2020) describe how clinical decision support systems have evolved since the 1980s into tools that augment clinician decision-making and are now commonly delivered through electronic medical records, while their effects on providers, outcomes, and costs remain incompletely understood. When designed appropriately, such systems shape which considerations become visible during a clinical encounter, and therefore which evidence is acted upon. Their capacity to do so depends on properties studied within the information-systems field, including interoperability between systems, adherence to shared data standards, and the quality and completeness of the data they hold.

Framing the gap in these terms yields three analytical dimensions that organise the remainder of this review. One concerns the accessibility of evidence in actionable formats, whether evidence is rendered as something a clinician can apply at the point of care. A second concerns its integration into planning and documentation workflows, so that recommendations are encountered within the systems already in use. A third concerns feedback, whether the data generated during treatment are captured in a form that allows practice to be audited and improved. Together these dimensions let the heterogeneous literature on digital implant dentistry be read as a single problem of evidence translation.

Method

This work is a narrative review. A narrative approach was preferred to a systematic or scoping review for reasons

of fit. The retained studies span different interventions, outcomes, and designs and share no common quantitative endpoint, which precludes meta-analysis. A scoping review would map the extent and range of the field, whereas the aim here was interpretive: to integrate heterogeneous findings around a single conceptual question, the role of information systems in evidence translation. The synthesis therefore proceeded by close reading of each full text, extraction of the mechanism, barrier, or facilitator that the study described, and iterative grouping of these into the three information-system dimensions that organise Section 5. The grouping was discussed among the three reviewers and revised until the categories accommodated all retained studies.
A structured search was conducted in the Scopus database on 25 May 2026 to identify records at the intersection of three concept blocks: implant treatment; the evidence-to-practice and knowledge-translation domain; and health information systems together with clinical decision support and digital planning. Searches were restricted to the title, abstract, and keyword fields and limited to English-language records published between 2015 and 2025. The exact search strings are reproduced in Appendix A.

A core search combining all three concept blocks was complemented by two flanking searches, each pairing the implant block with one of the remaining blocks, in order to capture the clinical and the information-system literature respectively. The core search returned six records, the implant-and-gap search six records, and the implant-and-information-systems search two hundred and eleven records, yielding two hundred and twenty-three records in total. After removal of two duplicates, two hundred and twenty-one records were screened independently by three reviewers at title and abstract level against predefined inclusion and exclusion criteria, with disagreements resolved by discussion until consensus was reached. Records concerning non-dental implants, and records addressing surgical technique, materials science, or device engineering without reference to evidence translation or information-system mechanisms, were excluded. Records were retained when they engaged with implant treatment as the clinical context and with at least one information-system dimension as a mechanism, barrier, or facilitator.

The inclusion criteria were, in full: a focus on dental, oral, or implant-supported treatment; engagement with the evidence-to-practice or knowledge-translation gap, with guideline adoption or adherence, or with the role of health information systems, clinical decision support, or digital planning; treatment of these as a mechanism, barrier, or facilitator rather than an incidental mention; peer-reviewed original articles or reviews; publication in English; and publication between 2015 and 2025. The exclusion criteria were: non-dental implants; a focus on surgical technique, materials science, or device engineering without reference to evidence translation or information-system mechanisms; the incidental mention of information systems only; editorials, letters, and conference abstracts without full text; and full text that could not be retrieved.

The majority of records were excluded at title and abstract screening, predominantly studies of guided-surgery accuracy and digital workflow, exemplified by work reporting the positional accuracy of fully digital planning and custom guides (Gallo et al., 2023), together with records concerning non-dental implants. Thirty records were assessed in full text, of which three were excluded as purely technical or redundant, leaving twenty-seven studies that form the basis for the present synthesis. Two features of the retrieval merit acknowledgement. First, the strict three-block intersection returned only six records, several of which proved tangential on inspection, which indicates that the core terminology of evidence translation is used sparingly in the implant literature. Second, the large flanking set was dominated by digital-technique studies that describe workflow without engaging the question of how evidence reaches practice, so the body of work genuinely addressing the research question is narrower than the raw retrieval volume would suggest, a finding that is itself informative.

The Evidence-Practice Gap in Implant Treatment

The clearest articulation of the gap in this field concerns the weak documentation of the very technologies that are promoted to improve care. The appraisal by Jokstad (2017) identified a large number of commercial digital products, of which only about one third had been described in clinical human studies, while the majority carried no clinical documentation at all. It also observed that the product life cycle of digital appliances is short, so that new tools frequently displace their predecessors before either has accumulated a meaningful evidence base. The evidence tends to lag behind the technology, and clinicians are left to adopt tools whose advantages are claimed without being demonstrated.

A second manifestation of the gap appears in treatment planning decisions, where consequential and recurrent choices are made with notable variability. Gönüldaş et al. (2025), in a survey-based comparison of implant planning decisions among prosthodontic and surgical residents, found that, although formal statistical testing did not always distinguish the groups, variation in treatment choices was nonetheless evident, and that the assessments

of different specialties did not consistently align. The decision of whether to retain a compromised natural tooth or to extract and replace it with an implant is similarly complex and multifactorial, depending on patient-related, periodontal, endodontic, and restorative considerations, and Al Shaltoni et al. (2025) characterise it as one of the most difficult judgements in restorative treatment planning. Where decisions of this importance lack a structured, evidence-anchored representation, outcomes will reasonably depend on individual experience instead of consolidated knowledge.

A third dimension concerns the quality and completeness of the evidence as it is reported. Sarkis-Onofre et al. (2020) showed that endorsement of reporting standards by journals is associated with improved completeness of randomised clinical trial reports in dentistry. Incomplete reporting is consequential precisely because it impedes the downstream translation of findings into practice, since recommendations cannot be applied with confidence when the trials underpinning them are inadequately described. The integrity of the translation chain therefore depends on the quality of the information at its source, not only on its eventual delivery. Finally, the determinants of implant outcomes are increasingly well characterised through retrospective and records-based research, yet this knowledge is unevenly translated into preventive practice. Cohort analyses have quantified the incidence and timing of early and late failures and their risk factors (Griffin et al., 2025; Miller et al., 2024), records-based work across multi-institutional networks has examined the relationship between periodontal status and implant outcomes (Chatzopoulos and Wolff, 2025), retrospective cohorts have assessed the survival of teeth adjacent to implants (Chen et al., 2024), and long-term analyses have documented the prosthetic complications of implant-supported restorations (Saponaro et al., 2023). These studies show that the data needed to inform risk-aware treatment exist and can be analysed. The difficulty is that such determinants are seldom surfaced at the moment of planning, where they would alter decisions, and remain instead within the research literature.

Health Information Systems as Translation Mechanisms

If the gap is partly an information problem, then the systems that capture and present clinical information are the natural locus for intervention. The literature retained for this review can be read as evidence about three such systems, considered in turn below.

Clinical decision support and decision-making

A growing body of work positions computational tools as decision support during implant planning. Che et al. (2025), in a multicentre evaluation of an artificial-intelligence-based three-dimensional implant planning tool, concluded that it demonstrated potential as a decision-support system, while noting discrepancies between the positions it generated and those ultimately adopted, and framing the tool as a supportive instrument used under clinician supervision and not as an autonomous planner. They also identified a benefit in standardising treatment planning, the operational form of consistent evidence application. Mun et al. (2025) designed a related deep-learning model to predict the number of implants required for patient-specific planning, reporting high accuracy in a single-centre setting and presenting it as a means of assisting less-experienced clinicians and of standardising planning, with multi-institutional validation identified as the necessary next step. The supportive framing recurs across the wider literature on artificial intelligence in prosthodontics and implant dentistry. Revilla-León et al. (2023), in a systematic review of such models, found promising performance in defined tasks, including the marking of restoration margins with reported accuracy in the approximate range of ninety to ninety-seven per cent, while concluding that the models remained in development and required further clinical assessment. Earlier, Alharbi and Almutiq (2022) reported high classification accuracy for machine-learning prediction of implant cases under experimental conditions. Diagnostic systems based on deep learning have also been developed to detect and identify implants on radiographs and to generate preliminary placement pathways from panoramic images, each positioned as an aid to clinical assessment and not a replacement for it (Lin et al., 2025; Wu et al., 2025). Across these heterogeneous tasks the literature converges on a common position: computational tools function as decision support that depends on human oversight. A comparison of implant planning decisions between clinicians and a large language model sharpens the point. Gönüldaş et al. (2025) compared the recommendations of a conversational model with those of prosthodontic and surgical residents and found the agreement between the model and either specialist group to be only fair, whereas the agreement between the two human groups was substantially higher. The model also exhibited a systematic preference for conservative options, and the authors concluded that such systems should be viewed as a complementary aid and not a substitute for expert judgement. A system can therefore surface considerations and encourage consistency, yet cannot at present be trusted to replace the clinical reasoning it is meant to support. Structured instruments developed without machine learning point in the same direction. Al Shaltoni et al. (2025) proposed a colour-coded prognostic tool intended to give

clinicians a structured, evidence-anchored approach to the notoriously variable decision of whether to preserve or extract a compromised tooth, and Emodi et al. (2025) applied digital planning to guide decision-making in a complex case of severe congenital oligodontia with associated malocclusion. Each represents a direct attempt to render consolidated evidence usable at the point of decision.

Structured recommendations and consensus instruments

Between primary evidence and the individual decision lie structured recommendations that consolidate evidence into usable guidance. Fontenele et al. (2025) show how decision-support charts that guide clinicians in selecting imaging parameters for differing indications reformat evidence into a directly applicable instrument instead of leaving it as narrative text. Herce-López et al. (2024) illustrate the analogous role of consensus reports for emerging interventions, drawing the available literature and expert judgement into a provisional standard where primary evidence is still accumulating, in their case for customised subperiosteal implants in atrophic jaws. Such instruments convert dispersed findings into a form that can be embedded within planning and documentation workflows, although their effectiveness depends on whether they are encountered within the systems clinicians already use or remain separate documents consulted voluntarily.

Registries and electronic health records

Registries and electronic health records constitute the information substrate on which durable evidence translation depends, because they capture the longitudinal outcome data through which practice can be evaluated and improved. Work on the establishment of a national dental implant registry is instructive. In a pilot exercise, Berge et al. (2025) registered more than one thousand three hundred implants placed in several hundred patients across multiple clinics over a two-year period and estimated a failure of approximately three per cent one year after insertion. They emphasised that successful registries depend on sustained interaction with clinicians, efficient data collection, regulatory compliance, and the disciplined selection of variables according to a need-to-know principle. These are information-system design requirements as much as clinical ones, and they determine whether a registry can generate generalisable success rates across diverse settings. Electronic health records offer a complementary route to evidence generation. Records-based studies have analysed implant outcomes across institutional and multi-institutional networks, examining relationships between systemic and periodontal conditions and implant failure and quantifying the determinants of failure in defined cohorts (Griffin et al., 2025; Miller et al., 2024; Chatzopoulos and Wolff, 2025; Chen et al., 2024). Their value for translation is twofold: they permit the retrospective analysis that establishes risk factors, and they could provide the channel through which those factors are returned to the clinician as structured prompts during future planning. The literature demonstrates the first capability convincingly. The second, closing the feedback loop from recorded outcome back to point-of-care recommendation, remains largely aspirational, and is one of the clearest opportunities for information systems to narrow the gap.

Patient-facing information

Translation is incomplete if it reaches only the clinician, because implant treatment depends on informed patient participation. The quality of patient-facing information is, however, frequently inadequate. Leira et al. (2019), assessing online information about peri-implantitis, found that the available material was poor in quality, with a low median quality rating and no website meeting all recognised transparency benchmarks, and that its readability exceeded the level recommended for patient comprehension. An earlier evaluation by Leira-Feijoo et al. (2015) of web-based information addressed to patients about dental implants reached comparable conclusions regarding reliability and accessibility. The public information environment surrounding implant treatment is therefore poorly aligned with the evidence and often not comprehensible to the patients it serves. Conversational artificial-intelligence systems have been proposed as a means of improving access to dental information, with mixed results. Othman et al. (2025) found that the more recent version of a widely used model produced more accurate and complete responses than its predecessor, while concluding that clinical application should remain under the supervision of human experts. The cautious conclusion mirrors that reached for decision support, and underlines a consistent theme across every category of system considered here: information technologies can extend the reach of evidence, yet cannot yet be relied upon to govern its application without expert oversight.

Discussion

Taken together, the retained literature points in a consistent direction. The evidence-to-practice gap in implant treatment is sustained chiefly by the weak translation of knowledge into accessible, structured, point-of-care forms, and only secondarily by any shortage of knowledge. The appraisal of digital products that reach the market without clinical documentation (Jokstad, 2017), the variability in consequential planning decisions (Gönüldaş et al., 2025; Al Shaltoni et al., 2025), and the unrealised potential of recorded outcome data to inform subsequent practice (Griffin et al., 2025; Miller et al., 2024; Chatzopoulos and Wolff, 2025; Chen et al., 2024; Berge et al., 2025) together identify translation, not discovery, as the binding constraint.

Health information systems are a plausible response to this constraint, but the evidence for their effectiveness as translation mechanisms is not yet conclusive. Across decision support, predictive modelling, and patient information alike, the studies converge on a supportive, not autonomous, role for the technology, with repeated insistence on human supervision (Che et al., 2025; Mun et al., 2025; Revilla-León et al., 2023; Othman et al., 2025) and demonstrated limits to the alignment between automated and expert judgement (Gönüldaş et al., 2025). Many capable tools have been validated only in single-centre or experimental settings (Mun et al., 2025; Alharbi and Almutiq, 2022), which restricts how far their benefits can be generalised, and the documentation deficit identified for digital products in general (Jokstad, 2017) applies to several of the systems proposed as remedies, whose capacity to improve outcomes has more often been asserted than shown.
The adoption of these systems is further shaped by conditions that lie outside the technical performance of any individual tool. Usability, fit with existing clinical workflow, interoperability between systems, adherence to common data standards, the quality of the underlying data, and clinician trust in system-generated recommendations are recurring determinants of whether a tool is used as intended. A decision-support instrument that is not encountered within the planning workflow, or a registry that imposes disproportionate data-entry burden, will not narrow the gap regardless of its underlying validity (Berge et al., 2025). The design and integration of information systems must therefore be treated as integral to evidence translation, not as a downstream implementation detail.

Several limitations qualify these conclusions. The review is narrative in design and not systematic, so the synthesis is thematic and no formal appraisal of risk of bias was undertaken. The search drew on a single database, Scopus, and the omission of other major sources such as MEDLINE, Web of Science, and Embase will have left relevant records unretrieved. The evidence base that remained after screening is small and heterogeneous, and the restriction to the period from 2015 to 2025 excludes earlier foundational work. The core three-block search also behaved inconsistently with the flanking searches, which points to minor differences in the underlying query terms and further limits the precision of the retrieval. These constraints mean that the conclusions should be read as an interpretive synthesis and a direction for further enquiry, not as a definitive account of the field.
These adoption conditions correspond to well-recognised implementation barriers. The categories identified by Cabana et al. (1999), from limited awareness to external constraints, have information-system counterparts: awareness and agreement depend on how evidence is surfaced, while external constraints include the interoperability, shared data standards, and workflow integration that determine whether a system can be used at all. Usability and workflow integration decide whether a decision-support tool is met at the moment of planning; standardisation, emphasised by Che et al. (2025) and Mun et al. (2025), is the consistency that evidence translation seeks; data quality and common standards decide whether registry and record data can be trusted and reused (Berge et al., 2025); and user trust, shown to be fragile where automated and expert judgement diverge (Gönüldaş et al., 2025), governs whether recommendations are accepted. The feedback loop from recorded outcome back to a point-of-care prompt is the least developed of these and closing it is where information systems could most plausibly narrow the gap.

Registries and electronic health records therefore occupy a particularly strategic position. They are the only systems among those considered that can both generate evidence, by accumulating longitudinal outcomes, and deliver it, by returning structured information to the point of care. Strengthening this substrate, and in particular closing the loop between recorded outcome and subsequent recommendation, may offer greater leverage than the continued proliferation of stand-alone planning tools.

Research Agenda and Future Directions

Three priorities follow from this synthesis. The first is evaluation. Rigorous, preferably multi-institutional studies are needed to test whether specific information systems measurably improve the consistency of decisions and the quality of outcomes relative to current practice, in place of further tools whose advantages are merely asserted (Che et al., 2025; Mun et al., 2025; Revilla-León et al., 2023). Such studies should report against recognised standards so that their findings can themselves be translated reliably (Sarkis-Onofre et al., 2020). A second priority concerns the feedback loop. Research should examine whether outcome data captured in registries and electronic health records can be returned to clinicians as structured, point-of-care prompts, and whether doing so alters planning decisions and reduces unwarranted variation (Berge et al., 2025). This treats the registry as an active component of the translation mechanism, and not as a passive archive. A third priority concerns the patient. Given the demonstrated inadequacy of public information (Leira et al., 2019; Leira-Feijoo et al., 2015) and the supervised promise of conversational systems (Othman et al., 2025), work is needed to determine how patient-facing information can be rendered both accurate and comprehensible, and how it can be integrated with the clinician-facing systems so that clinician and patient draw on a consistent evidence base. Across all three priorities, the unit of evaluation should be the information system in its clinical context, including its usability, workflow fit, and interoperability, and not the algorithm or device in isolation. What matters is less whether a tool performs accurately under test conditions than whether it carries evidence to the point of decision in routine use.

Conclusion

A persistent distance remains between what the evidence supports and what is routinely practised in implant treatment. This review has argued that the distance is best understood as an information management problem, and that health information systems, comprising clinical decision support, registries and electronic health records, and patient-facing information, are the natural mechanisms through which evidence might be carried to the point of care. The available literature indicates that these systems are promising but not yet proven, and that their value depends as much on design and integration as on technical performance. Positioning the gap at the intersection of clinical practice and health information systems clarifies where the most consequential research now lies: in the rigorous evaluation of these systems as instruments of evidence translation, and in closing the loop between recorded outcome and clinical decision.

Appendix A: Scopus search strings

The search was carried out on 25 May 2026 and limited to English-language records published between 2015 and 2025 (PUBYEAR > 2014 AND PUBYEAR < 2026). Block 1 (implant), Block 2 (evidence-to-practice) and Block 3 (health information systems) are combined as shown. Search 1 returned 6 records, Search 2 returned 6 records, and Search 3 returned 211 records.

Search 1 (core): Block 1 AND Block 2 AND Block 3

TITLE-ABS-KEY (("dental implant*" OR "oral implant*" OR "implant dentistry" OR "implant-supported" OR "implant therap*" OR "implant treatment*" OR implantolog*) AND ("evidence-practice gap" OR "evidence to practice" OR "research-practice gap" OR "know-do gap" OR "knowledge translation" OR "knowledge-to-action" OR "evidence implementation" OR "guideline adheren*" OR "guideline implementation" OR "implementation science") AND ("health information system*" OR "clinical decision support*" OR "decision support system*" OR "digital health" OR ehealth OR e-health OR "electronic health record*" OR "health informatics" OR "clinical informatics" OR "digital planning")) AND PUBYEAR > 2014 AND PUBYEAR < 2026

Search 2 (implant AND evidence-to-practice): Block 1 AND Block 2

TITLE-ABS-KEY (("dental implant*" OR "oral implant*" OR "implant dentistry" OR "implant-supported" OR "implant therap*" OR "implant treatment*" OR implantolog*) AND ("evidence-practice gap" OR "evidence to practice" OR "research-practice gap" OR "know-do gap" OR "knowledge translation" OR "knowledge-to-action" OR "evidence implementation" OR "guideline adheren*" OR "guideline implementation" OR "implementation science")) AND PUBYEAR > 2014 AND PUBYEAR < 2026

Search 3 (implant AND health information systems): Block 1 AND Block 3

TITLE-ABS-KEY (("dental implant*" OR "oral implant*" OR "implant dentistry" OR "implant-supported" OR "implant therap*" OR "implant treatment*" OR implantolog*) AND ("health information system*" OR "clinical decision support*" OR "decision support system*" OR "digital health" OR ehealth OR e-health OR "electronic health record*" OR "health informatics" OR "clinical informatics" OR "digital planning")) AND PUBYEAR > 2014 AND PUBYEAR < 2026

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