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Reviews

- Development of evidence-based medicine and introduction to Korea
- Step-by-step guide to meta-analysis of clinical trials using RevMan web version
- The use of evidence in decision-making in the context of Korean healthcare: a review
- Artificial intelligence assisted semi-automation tools using for systematic reviews and guideline development



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Journal of Evidence-Based Practice (J Evid-Based Pract, JEBP) aims to present 1) Original evidence-based research on important issues in healthcare, 2) Methods, tools, and concepts essential for evidence-based medicine (EBM), education and practice, 3) Perspectives, debates, analyses, and opinions on reliable evidence and related topics in evidence-based medicine.

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Development of evidence-based medicine and introduction to Korea

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Evidence-Based Medicine (EBM) demands systematic changes across the healthcare system, essential for enhancing patient safety and quality of medical care. To address the question, "Are we adopting scientific methods to optimize patient safety and enhance treatment efficacy?", assessing the level of EBM implementation is crucial. The adoption rate of evidence-based medical practices varies across countries and medical fields, often being lower in resource-limited settings. In South Korea, there have been several documented cases where the adoption of non-evidence-based practices, such as CARVAR surgical procedures not based on scientific evidence, has led to severe patient safety issues, thereby raising significant concerns about the quality of medical care provided. Conversely, the ABBA Study exemplifies successful application of EBM, demonstrating how scientific research assessed the risk of intracranial hemorrhage in patients with low-dose PPA in OTC cold medicines. This study not only confirmed the associated risks but also influenced health policy, resulting in the withdrawal for PPA-containing OTC cold medicines in Korea. This positive example highlights the imperative for governments, healthcare institutions, and medical schools to expedite the transition to evidence-based, patient-centered healthcare by fostering a robust commitment to systematic reviews and enhanced support for clinical research. The Korean Society of Evidence-Based Medicine (KSEBM) is expected to play a significant role in embedding these core strategies domestically

Keywords: Evidence-Based Medicine (EBM); Patient Safety; Quality of Medicalcare; Systematic Review; Health Policy

Introduction

Evidence-Based Medicine (EBM) emphasizes the importance of scientific evidence in the clinical decision-making process. It has become an essential element in enhancing the quality of healthcare services provided to patients.

The term "evidence-based medicine" was first introduced in 1992 by Gordon Guyatt and Drummond Rennie at McMaster University in Canada, and was later defined by David Sackett in 1996 as "the conscientious, explicit, and judicious use of the current best evidence in making decisions about the care of individual patients." This concept quickly gained global recognition and adoption.

Meanwhile, the World Health Organization (WHO) proposed the concepts of "evidence-informed policy" and "evidence-informed decision making" when emphasizing the importance of utilizing evidence in healthcare policymaking. The WHO stresses that policymaking based on evidence should not be limited to rational execution but must evolve into a deliberative process aimed at achieving fair and reasonable decisions [1].

In Korea, the introduction and advancement of EBM have been driven by the active participation of major public healthcare institutions and medical societies. In 2003, the Health Insurance Review & Assessment Service (HIRA) established the New Health Technology Assessment Team to

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apply evidence-based decision-making. In 2006, it further launched the Evidence-Based Healthcare Team. Following the 2007 amendment of Article 53 of the Medical Service Act, the New Health Technology Assessment System was legislated, enabling the clinical evaluation of the safety and efficacy of new medical technologies based on EBM principles.

Simultaneously, the Korean Academy of Medical Sciences and the Korean Medical Association developed standardized clinical practice guidelines and, in 2008, founded the Korean Medical Guidelines Information Center(KoMGI). In the same year, the National Evidence-based healthcare Collaborating Agency (NECA) was established, significantly contributing to the development of evidence-based healthcare policies. These efforts have played a crucial role in improving the quality of healthcare in Korea.

In this paper, we aim to outline the necessity and development of evidence-based medicine, introduce practical application cases, and encourage healthcare professionals to recognize the importance of EBM and actively incorporate it into patient care.

Application Level of Evidence-Based Clinical Practice: A Review of Previous Studies

Evidence-Based Medicine (EBM) is a core element for improving the quality of healthcare. Understanding the extent to which EBM is actually applied in various healthcare settings provides critical insight into the necessity for its implementation and the strategic direction for its expansion.

A review of major previous studies indicates that the application rates of EBM in clinical practice vary by country and medical specialty, but generally fall within the range of approximately 70–80%.

In a study conducted by Ellis (1995), it was reported that 82.0% of clinical decisions at a district general hospital in

the United Kingdom were based on evidence [2]. Similarly, Gill (1996) reported an application rate of 81.0% at a British teaching hospital, suggesting a relatively high level of EBM practice in primary care settings within the UK [3].

In North America, comparably high application rates have also been observed. Lee JS (2000) reported a 78.0% application rate in the field of thoracic surgery [4], while Khan AT (2006) found a notably high rate of 90.0% in the field of obstetrics and gynecology. In ophthalmology, varying degrees of EBM application have been documented [5]. Lai TYY (2003) reported a 77.0% application rate at an ophthalmology hospital in Hong Kong [6], and Bhatt & Sandramouli (2007) reported an 89.7% application rate in an ophthalmic emergency department in the UK [7]. Despite regional and specialty differences, these findings suggest a relatively stable practice rate of EBM in the ophthalmology field.

Conversely, lower rates have been observed in other settings. Ebell (2017) reported that the EBM application rate in U.S. primary care clinics was 52.0% [8], and Megersa et al. (2023) reported an application rate of 48.4% among nurses working at public hospitals in Ethiopia [9]. These differences likely reflect the influence of multiple factors, including healthcare delivery system characteristics, clinical decision-making autonomy, accessibility to evidence, and the level of professional education (Table 1).

Taken together, these results suggest that the degree of EBM implementation varies depending on the medical specialty, national context, and healthcare infrastructure. In primary care settings and environments with relatively limited resources, the level of EBM practice tends to be lower. This highlights the need for not only the dissemination of guidelines but also the strengthening of healthcare providers' competencies and the provision of structural support to promote the effective implementation of evidence-based medicine.

Table 1. Studies on the Application Rate of Evidence-Based Clinical Practice

Researcher	Publication	Study population	Application rate of EBM practice	Number of reference
Ellis J	Lancet, 1995	General practice, university-affiliated hospital (UK)	82.0%	[2]
Gill P	BMJ, 1996	General practice, suburban training hospital (UK)	81.0%	[3]
Lee JS	Ann Thorac Surg, 2000	Thoracic surgery, tertiary and general hospital (North America)	78.0%	[4]
Khan AT	BMC Women's Health, 2006	Obstetrics and gynecology, tertiary hospital (North America)	90.0%	[5]
Lai TYY	Br J Ophthalmol, 2003	Ophthalmology practice, eye hospital (Hong Kong)	77.0%	[6]
Bhatt R & Sandramouli S	Eye, 2007	Emergency Ophthalmology Department (UK)	89.7%	[7]
Mark Ebell	BMJ Evidence-Based Medicine, 2017	Primary care, general and family medicine (USA)	52.0%	[8]
Megersa Y, et al.	BMJ Open, 2023	Public hospital (nurses targeted) (Ethiopia)	48.4%	[9]

The Necessity of Introducing Evidence-Based Medicine

The necessity of introducing Evidence-Based Medicine (EBM) extends beyond the mere scientification of clinical practice; it is directly tied to fundamental principles across healthcare, including the protection of patient rights, the enhancement of medical reliability, and the efficient allocation of healthcare resources. Especially as medical care becomes increasingly complex and the range of available treatments expands, establishing objective criteria for determining “the most appropriate treatment” is more critical than ever.

First, EBM serves as an institutional mechanism to safeguard patients' rights to safe and effective treatments. For instance, bariatric surgery for obesity may be effective under specific circumstances, but when performed indiscriminately without established indications or long-term evidence, it can lead to serious adverse outcomes both for individual patients and society at large [10]. Another notable example is the CARVAR (Comprehensive Aortic Root and Valve Repair) surgery, which rapidly spread in Korea during the 2000s without adequate clinical trials, generating significant ethical and medical controversies. This case starkly illustrates the risks associated with medical practices that lack prior scientific validation.

Second, even widely used medical technologies may sometimes be lacking in solid evidence or have uncertain effectiveness. For example, combination analgesic therapies, injection treatments, and repeated imaging studies for functional disorders are routinely employed despite insufficient validation through randomized controlled trials (RCTs). A systematic review evaluating the efficacy of epidural steroid injections for chronic low back pain concluded that their long-term effectiveness in pain reduction was limited [11]. This suggests that the widespread use of a medical intervention does not in itself guarantee its legitimacy.

Third, even when evidence exists, the conclusions drawn from it can vary significantly depending on the quality of the evidence. Arthroscopic surgery for degenerative knee osteoarthritis serves as a prime example: although it was widely practiced for many years, high-quality RCTs later demonstrated no significant difference between arthroscopic surgery and sham surgery, thereby questioning its clinical efficacy [12]. These findings underscore the importance of critically appraising the level of evidence, as high-quality, bias-controlled research can lead to markedly different medical conclusions compared to low-quality studies.

Fourth, there are instances where, despite the existence of strong evidence, clinical adoption was delayed, further

highlighting the necessity for EBM. The administration of antenatal corticosteroids to prevent neonatal respiratory distress syndrome was proven effective through RCTs as early as the 1970s [13]. However, it took until the late 1990s for this intervention to be widely adopted in clinical practice due to delays in the dissemination and acceptance of the evidence. Considering the lives of newborns lost to respiratory distress syndrome during that interim period, the critical importance of timely evidence-based adoption cannot be overstated.

Fifth, while the expert judgment of clinicians remains indispensable, decision-making based solely on experience or authority has clear limitations. For example, in the 1970s, Linus Pauling advocated the use of high-dose vitamin C for the treatment of the common cold and cancer [14], yet subsequent large-scale clinical trials demonstrated a lack of scientific support for his claims [15]. This case serves as a cautionary example: even recommendations from prominent authorities can lead to the spread of distorted medical information if they are not grounded in robust scientific evidence.

Finally, in today's digital era, healthcare professionals face not a shortage of information, but an overabundance. In such an environment, the ability to critically appraise, select, and apply reliable evidence becomes paramount. EBM functions as a systematic tool to evaluate the quality of diverse sources, synthesize findings, and support clinical decision-making amidst a flood of information.

In conclusion, EBM is clearly an indispensable foundation not merely for introducing advanced medical techniques but also for securing the ethicality, efficiency, and credibility of healthcare. In Korea, responding to the increasingly sophisticated demands of the healthcare system requires not only embedding EBM into medical education and clinical practice but also strengthening institutional frameworks. Governmental support for research, guideline development, and implementation strategies must accompany these efforts to firmly establish evidence-based practice across the healthcare system.

Expansion and Evolution of Evidence-Based Medicine: From Concept Formation to the AI Era

Evidence-Based Medicine (EBM), whose necessity is now emphasized more than ever, is not a concept that emerged overnight. Rather, it represents a paradigm that gradually took root through decades of academic discourse and clinical necessity, forming a cornerstone of modern medicine. Especially from the 1980s onward, amid efforts to enhance the scientific validity of healthcare, EBM began to establish its

academic identity. In the 21st century, it has entered a new stage through integration with artificial intelligence (AI) and machine learning technologies.

The conceptual foundation of EBM was laid by David Sackett. In his seminal 1981 paper, "How to Read Clinical Journals", he encouraged healthcare professionals to critically appraise clinical journal articles and integrate the extracted evidence into their clinical decision-making processes [16]. This went beyond merely suggesting a methodology—it proposed the systematic introduction of scientific thinking and critical appraisal principles across all medical practices.

In his 1991 book "Clinical Epidemiology: A Basic Science for Clinical Medicine", Sackett further defined clinical epidemiology as the "basic science" of clinical medicine, emphasizing the necessity of systematically evaluating and utilizing evidence for diagnosis, treatment, and prognosis [17].

That same year, Guyatt explicitly introduced the term "evidence-based medicine (EBM)", defining it as the integration of clinical expertise, patient values, and the best available external evidence in the decision-making process [18].

Sackett et al.'s classic 1996 paper, "Evidence-Based Medicine: What It Is and What It Isn't", provided a clearer articulation of the concept [19]. The authors warned against the misconception of EBM as the mechanical application of randomized controlled trial results. Instead, they framed EBM as a process that integrates an understanding of the individual patient's circumstances and expert's clinical decision process with the best available scientific evidence. This balanced

definition provided both the ethical justification and practical applicability for EBM, facilitating its widespread global adoption.

In his historical overview, Zimmerman (2013) characterized EBM as a transformative movement that restructured modern medicine [20]. He analyzed the shift from an authority-centered model of care to an evidence-centered decision-making structure. Similarly, Smith & Rennie (2014) reconstructed the conceptual formation, dissemination, and internal debates of EBM through interviews with key contributors [21]. Their work highlights that EBM did not emerge as a singular academic theory but rather evolved as a body of practical knowledge at the intersection of clinical realities and health policy.

Building on such academic foundations, it became evident that the various types of evidence comprising EBM are organized within a structured hierarchy based on scientific rigor. At the top of this hierarchy are systematic reviews and meta-analyses, followed by randomized controlled trials (RCTs), cohort studies, case-control studies, case series, and case reports.

This classification serves as a framework for assessing the validity and strength of the evidence produced by each study design. Systematic reviews and meta-analyses offer the highest level of persuasive power, providing the most reliable evidence to guide both clinical decision-making and healthcare policy formulation (Fig. 1).

Meanwhile, in the era of artificial intelligence (AI), the hier-

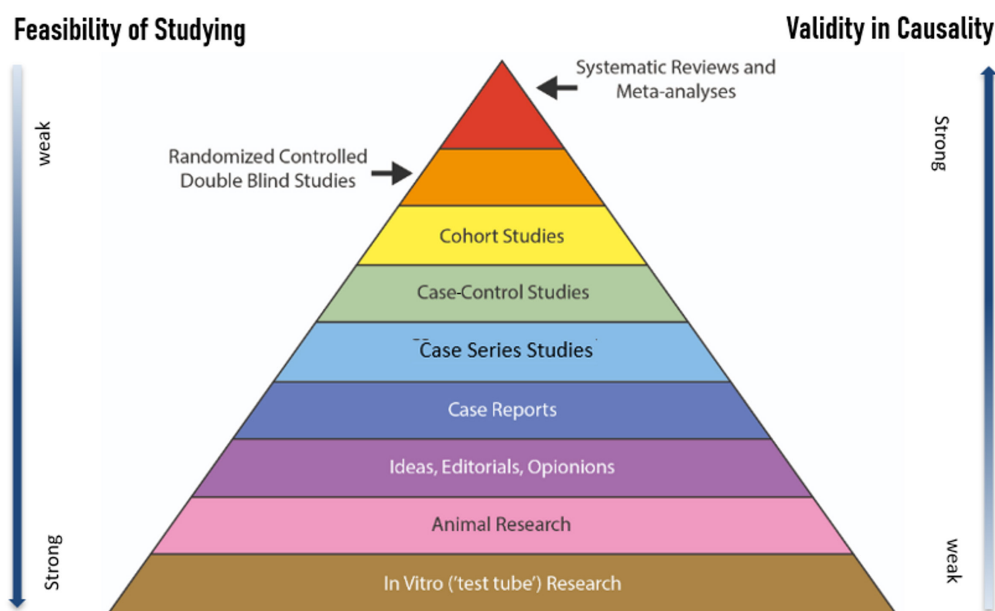


Fig. 1. Hierarchy of Scientific Evidence for Clinical decision-making.

archy of evidence based on research design has become even more critical. As data technologies advance, AI contributes to medicine by analyzing large-scale datasets to generate more precise clinical insights.

Chaoyuan Liu et al. (2018) evaluated the accuracy and feasibility of AI-generated treatment recommendations compared to clinical judgments made by physicians for patients with lung cancer in China [22]. This study demonstrated that decision-making processes, which traditionally relied heavily on clinical experience, can now be increasingly structured through AI. Importantly, it opened the possibility for AI to serve not as *automatic application*, but as a *cognitive aid* that enhances evidence-based clinical practice without reducing it to mechanical execution.

Moreover, Loughlin et al. (2021) explored how ethical and practical challenges are being redefined in clinical environments where AI and EBM are integrated [23]. They discussed how evidence provided by machine learning systems must harmonize with clinician-patient interactions, value judgments, and contextual interpretations, rather than remaining

as mere statistical predictions.

Building on this, McCradden et al. (2025) proposed a comprehensive evaluation framework when applying AI-based clinical decision support systems in pediatric emergency care, addressing not only technical performance but also ethical justification and legal accountability [24].

These developments illustrate that EBM is evolving beyond simply answering “what is the best treatment” to also engaging in deeper philosophical and ethical discussions regarding “how decisions should be made” (Table 2).

In summary, Evidence-Based Medicine does not merely signify the “technologization of medicine.” Rather, it represents a transformative journey from decision-making based on experience and authority toward a new clinical culture that integrates scientific evidence with patient-centered values.

Today, this journey is becoming increasingly sophisticated through the incorporation of AI and data-driven technologies, while simultaneously demanding a redefinition of ethical standards.

Table 2. The Formation and Expansion of the Concept of EBM

Researcher	Title	Year	Journal	Subjects and conclusion	Number of reference
Sackett D	How to read clinical journals	1981	Can Med Assoc J	Provides guidance on critically reading clinical journals, emphasizing the application of evidence-based medicine principles.	[16]
Sackett D, et al.	Clinical Epidemiology: a basic science for clinical medicine	1991	Little Brown	Explores principles of clinical epidemiology and discusses in-depth the application of evidence-based medicine.	[17]
Guyatt G	Evidence-based Medicine	1991	Ann Intern Med	Introduces and explains the necessity of evidence-based medicine in medical practice.	[18]
Sackett D, et al.	Evidence based medicine: what it is and what it isn't	1996	BMJ	Clarifies the definition and significance of evidence-based medicine, highlighting its role in clinical decision-making.	[19]
Zimmerman A	Evidence-based medicine: a short history of a modern medical movement	2013	AMA Journal of Ethics	Overviews the history of evidence-based medicine and its impact on modern medicine.	[20]
Smith R, Rennie D	Evidence based medicine—an oral history	2014	BMJ	Analyzes the development and history of evidence-based medicine through key figure interviews.	[21]
Liu C, et al.	Artificial intelligence-based clinical decision support for cancer treatment	2018	Journal of Medical Internet Research	Assesses the accuracy and feasibility of AI in treatment recommendations for lung cancer patients in China.	[22]
Michael L, et al.	Humans, machines and decisions: Clinical reasoning in the age of artificial intelligence, evidence-based medicine and Covid-19	2021	Journal of Evaluation in Clinical Practice	Explores ethical and practical challenges in clinical decision-making using AI and evidence-based medicine.	[23]
McCradden MD, et al.	What makes a good' decision? An empirical theoretical study in pediatric practice	2025	BMJ Evidence-Based Medicine	Develops a clinical decision-making framework for individual patient interventions at a pediatric hospital using machine learning models.	[24]

Amidst these changes, it would be no exaggeration to assert that EBM is evolving from a focus on “how to secure and apply evidence” to a deeper emphasis on “how to derive patient-centered decisions.”

Application of Evidence-Based Medicine in Korean Clinical Practice

Evidence-based medicine (EBM) emphasizes the integration of scientific evidence into clinical decision-making and is increasingly recognized as a core principle for improving patient safety and the quality of healthcare. However, its actual application in Korea shows considerable variability depending on the specific context, and outcomes differ markedly according to the availability of supporting evidence. This section contrasts two representative cases: the CARVAR surgery, introduced without adequate scientific validation, and the ABBA Study, in which systematic evidence generation was directly linked to policy implementation. Through this comparison, we aim to explore the impact of EBM practice on healthcare policy and clinical settings.

CARVAR (Comprehensive Aortic Root and Valve Reconstruction) surgery, a novel type of cardiac procedure involving simultaneous remodeling of the aortic root and valve, attracted attention in Korea as a potential alternative to conventional aortic valve replacement. Advocates claimed it could preserve anatomical structures, maintain physiological function, and avoid long-term anticoagulant use, making it appealing for elderly patients with valvular heart disease [25]. Despite these expectations, CARVAR surgery was introduced into clinical practice without the support of well-designed clinical trials, raising major concerns.

At the time of introduction, only limited animal data regarding safety were available, and no clinical trials had been conducted. By contrast, a similar technique—CAVIAAR, proposed by Emmanuel Lansac—was registered with the U.S. National Institutes of Health (NIH) and was being tested in a multicenter randomized controlled trial [26]. In Korea, however, CARVAR was adopted without even basic information-sharing on such ongoing studies. Following its introduction, no systematic evaluation of patient outcomes or objective technology assessments were performed. Nevertheless, despite concerns over insufficient evidence, the procedure was temporarily approved under conditional non-reimbursement. A retrospective report was later submitted [27], but prospective trials were never undertaken. This case clearly illustrates how applying unverified medical technologies in clinical practice can endanger patient safety, undermine trust in healthcare, and create policy confusion.

In contrast, the ABBA (Acute Brain Bleeding Analysis) Study is widely regarded as a successful example of systematic evidence generation directly influencing national drug regulation. The study was initiated after the U.S. FDA reported that phenylpropanolamine (PPA), previously used as an anti-obesity agent, increased the risk of hemorrhagic stroke. While single-agent formulations were withdrawn in both the U.S. and Korea, the safety of small doses of PPA contained in combination cold medications remained unevaluated in the U.S., prompting a domestic investigation.

From 2002 to 2004, a nationwide prospective case-control study was conducted across 33 hospitals. Patients aged 30–74 years hospitalized for intracerebral or subarachnoid hemorrhage were matched 1:2 with hospital and community controls based on age and sex. Exposure to PPA and potential confounding variables were systematically assessed [28]. Conditional logistic regression revealed that recent PPA use (within 3 days) was associated with a significantly increased risk of hemorrhagic stroke, with an adjusted odds ratio (aOR) of 5.36 (95% CI: 1.40–20.46). Use within 14 days also showed a trend toward increased risk (aOR 2.14, 95% CI: 0.94–4.84), though without statistical significance. The effect was particularly pronounced among women. These findings demonstrated that even small amounts of PPA in cold medications could contribute to hemorrhagic stroke. Based on these results, the Korean Ministry of Food and Drug Safety mandated the withdrawal of all PPA-containing cold medications from the domestic market in August 2004.

The ABBA Study stands as the first large-scale domestic clinical investigation in which evidence directly informed regulatory policy. Its systematic design, nationwide collaboration, and seamless integration from data collection to policy implementation exemplify how evidence generation and policymaking can be effectively linked.

These two contrasting cases demonstrate the transformative role of EBM in healthcare. The CARVAR surgery highlights the risks of adopting new technologies without adequate scientific validation, whereas the ABBA Study illustrates the successful translation of robust evidence into policy action. Together, they provide several key lessons for the Korean healthcare system:

Rigorous Pre-Implementation Validation – All medical technologies must undergo thorough scientific evaluation, ideally through prospective clinical research and institutionalized technology assessment, before adoption.

Evidence-to-Policy Integration – When evidence is established, mechanisms should ensure its timely translation into practical policy, requiring close collaboration between regulators, researchers, and clinicians.

Multidisciplinary and Multicenter Collaboration – Building structural frameworks for large-scale, collaborative research tailored to the Korean population is essential to generate reliable evidence and establish EBM as a functional standard of care.

These lessons underscore that EBM is not merely a theoretical principle but a practical foundation capable of reshaping both clinical practice and healthcare policy.

Conclusion and Recommendations: The Importance of the Korean Society of Evidence-Based Medicine

Evidence-Based Medicine (EBM) has firmly established itself as a core principle for improving the quality of modern healthcare, and its importance is expected to grow even further within Korea's healthcare system. As technological advances such as artificial intelligence, big data, and precision medicine rapidly transform the medical environment, the ability to critically select and interpret reliable evidence amid a flood of clinical information will become an essential competency.

In particular, as shared decision-making between clinicians and patients becomes increasingly emphasized, EBM is expected to evolve into a standard for more human-centered and ethically grounded medical practice. Furthermore, EBM will occupy a central role in broader areas of public health policy, including the design of data-driven policies and the realization of value-based healthcare systems.

To realize this vision, institutional and structural reforms must accompany these trends.

First, at the governmental level, long-term investment in systematic reviews and clinical research, along with the establishment of comprehensive evaluation systems, is necessary. To accumulate practical evidence directly applicable to clinical practice, it is critical to prioritize research funding allocation and institutionalize evidence-based effect analysis frameworks both before and after the introduction of new technologies. Strengthening information sharing and decision-making coordination among agencies such as the Ministry of Food and Drug Safety, the Ministry of Health and Welfare, and the Health Insurance Review and Assessment Service is also essential to ensure that research findings are effectively reflected in policy.

Healthcare institutions must foster environments that actively support the autonomous practice of EBM. Hospitals should establish infrastructure that enables the planning and execution of clinical research, including dedicated research personnel and data support systems. Additionally, they must

develop educational and feedback mechanisms to enhance healthcare professionals' capabilities in utilizing evidence. EBM must be ingrained into organizational culture as a means to improve not only short-term clinical outcomes but also patient safety and the overall quality of medical care.

Medical schools and health education institutions should firmly establish EBM as a core component of their curricula. Systematic education should encompass methods for conducting systematic reviews and meta-analyses, including hypothesis generation, searching medical literatures relevant to the hypothesis, critical appraisal of the literatures, statistical analysis and interpretation, and integration of clinical judgment with evidence. By nurturing healthcare professionals capable of making evidence-based decisions, EBM can be effectively disseminated across the entire healthcare sector. Furthermore, educational collaborations between tertiary hospitals and primary care facilities should be encouraged to ensure the balanced and widespread adoption of EBM beyond specialized expert groups.

Finally, the Korean Society of Evidence-Based Medicine is expected to play a pivotal role in this transformation. To ensure patient safety, maximize treatment effectiveness, and restore public trust in healthcare, it is essential for EBM to be rapidly and thoroughly embedded into healthcare policy and clinical practice.

The shift in perception, establishment of institutional frameworks, and active initiatives by the Korean Society of Evidence-Based Medicine will not only drive the improvement of healthcare quality but also serve as essential prerequisites for building a sustainable healthcare system in Korea.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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All data generated or analyzed during this study are included in this published article and its supplementary information files.

Ethics Approval and Consent to Participate

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Step-by-step guide to meta-analysis of clinical trials using RevMan web version

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This paper focuses on basic meta-analyses using the updated RevMan Web version, based on the Cochrane Handbook of Systematic Reviews of Interventions for clinical trials. Theoretical statistical knowledge, such as the REML method for estimating heterogeneity variance in random-effects meta-analyses, the HKSJ method for reflecting the uncertainty of pooled estimates, and the prediction interval in a random-effects model for exploring true treatment effects in a future trial, is briefly described. Examples with synthetic data are presented to help with the understanding of meta-analysts.

Keywords: RevMan web; Random effects meta-analysis; HKSJ method; Prediction interval

Introduction

Meta-analysis is a quantitative method that synthesizes results from two or more separate studies under systematic review or the development of clinical practice guidelines. Meta-analysis of randomized trials generates an overall pooled estimate with its confidence interval that summarizes the effectiveness of an experimental intervention compared with a comparison [1]. There are many statistical software packages such as SAS, R studio, STATA, SPSS and Cochrane's Review Manager (RevMan) with free access or a subscription [2].

However, clinicians, nurses, or researchers need up-to-date theoretical knowledge and properly implement the software program to conduct a correct meta-analysis. Especially, researchers should consider the following three methods whether they apply the up to date approach in their random effects meta-analysis: the first, the Cochrane Handbook for Systematic Reviews of Interventions updated that the Restricted Maximum Likelihood (REML) method offers a more reliable estimation of heterogeneity variance of random-effects

meta-analyses rather than the DerSimonian and Laird moment-based method, because the fact that most systematic reviews and meta-analyses do not have enough studies to allow for reliable investigation of heterogeneity's causes [3]. In the RevMan web version, Restricted Maximum Likelihood (REML) is set as the default method for estimating between-study variance, although the DerSimonian and Laird moment-based approach is retained as an additional option [4].

Second, meta-analysts often face the problem of a small number of available studies due to the lack of large trials. Moreover, small studies have been found to show more heterogeneity than large trials [5]. When the number of studies is small with different sample sizes and there is moderate or substantial heterogeneity, the Hartung-Knapp-Sidik-Jonkman (HKSJ) method yields more accurate confidence intervals for the summary effect compared with the commonly used DerSimonian and Laird random effects method [6]. By constructing the confidence interval based on the t-distribution with k-1 degrees of freedom, the HKSJ method

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improved coverage probability compared to the DerSimonian and Laird method using a Wald-type statistic based on the standard normal distribution [7]. This approach generally inflates the variance of the summary effect and widens the confidence interval to reflect the uncertainty in estimating between-study heterogeneity. However, when the number of studies included in the meta-analysis is few or the dataset contains rare events, HKSJ confidence intervals may become overly wide [5]. Hence, confidence intervals must be calculated using Wald-type CI methods when meta-analyses include two or fewer studies [4]. In contrast, the use of the HKSJ method is recommended when the between-study variance estimate exceeds zero and the number of available study results is greater than two, although the default confidence interval method for the summary effect in the RevMan web version is the Wald-type method [1].

Third, neither of the measures of between-study heterogeneity such as τ^2 , nor the inconsistency measure I^2 , can provide insight into the clinical implications of the observed heterogeneity. The prediction interval in a random-effects model contains highly probable values for the true treatment effects in future settings, if those settings are similar to the settings in the meta-analysis [8]. The confidence interval only addresses the accuracy of the combined effect of the existing studies in a meta-analysis, whereas the prediction interval encompasses both the uncertainties in the combined effect and the potential heterogeneity between a future study and the existing evidence [9]. The values in the prediction interval can be compared with clinically relevant thresholds to see whether they correspond to benefit, null effects or harm [8]. Depending on the extent of heterogeneity, the prediction interval is generally wider than the corresponding confidence interval; in the absence of observed heterogeneity, the prediction interval is identical to the confidence interval [9]. However, in a meta-analysis with few studies (eg, fewer than 5 studies), the prediction interval may be particularly imprecise, resulting from an imprecise estimation of the summary effect size and heterogeneity parameter [10]. Prediction intervals can optionally be calculated in RevMan web.

Step-By-Step Guide To Meta-Analysis Using Revman Web Version

Access to the RevMan web

The RevMan web version is available through <https://revman.cochrane.org/info>. Recently, Cochrane RevMan was changed from free software to an annual subscription. Cochrane reviewers are available free in RevMan, whereas the others require a yearly subscription. In updating profiles, the

discount rate is automatically applied for students and academics.

Using the Cochrane account, users can log in to RevMan. Individuals or Cochrane users create and manage an unlimited number of reviews to conduct meta-analysis and present the results in forest plots with funnel plots [11]. In this article, synthetic data were used to compare high-intensity laser therapy (HILT) with controls for pain reduction in musculoskeletal conditions, including low back pain, frozen shoulder, and neck pain, as examples. The paper focused on basic meta-analysis, although RevMan web version allows the import of Risk of Bias 1 or 2 assessments for both Cochrane and non-Cochrane intervention reviews, and it supports GRADEpro Guideline Development Tool integration exclusively for Cochrane reviews.

Creating my reviews

After creating a Cochrane account, users could log in and add a practice review to try out this software for 30 days without a subscription. Practice reviews will be available to only one person and cannot be exported. If users are subscribers of RevMan web version, researchers can create a new review, including the title, and select review types such as intervention review, rapid review, prognosis review, and others, by clicking 'New review' as a permanent review in the Portfolio (Fig. 1).

Establishing review criteria

After generating my reviews, the users need to click on the review, the Dashboard will be displayed on the webpage. In the left column, the first item under the Data section is Review Criteria, which defines the eligibility framework for the review. These include Interventions, Intervention Groupings, Outcomes, Covariates, Characteristics, and Risk of Bias.

Interventions specify the most detailed list of eligible interventions and controls. Intervention Groupings enable the restructuring of multi-arm trials (more than two interventions) into two-arm groups. Outcomes define the endpoints of interest, allowing users to specify outcomes with descriptions, data types, units of measurement, and directions (e.g., higher values indicate improvement, while lower values indicate deterioration). Among the Review criteria, researchers should specify Interventions, Intervention groupings, Outcomes, and Risk of bias to conduct either automatic or manual analysis. However, if researchers plan to conduct subgroup analyses using study-centric data, covariates need to be determined at this stage. Covariates indicate study characteristics that might influence the size of an intervention effect (Fig. 2).

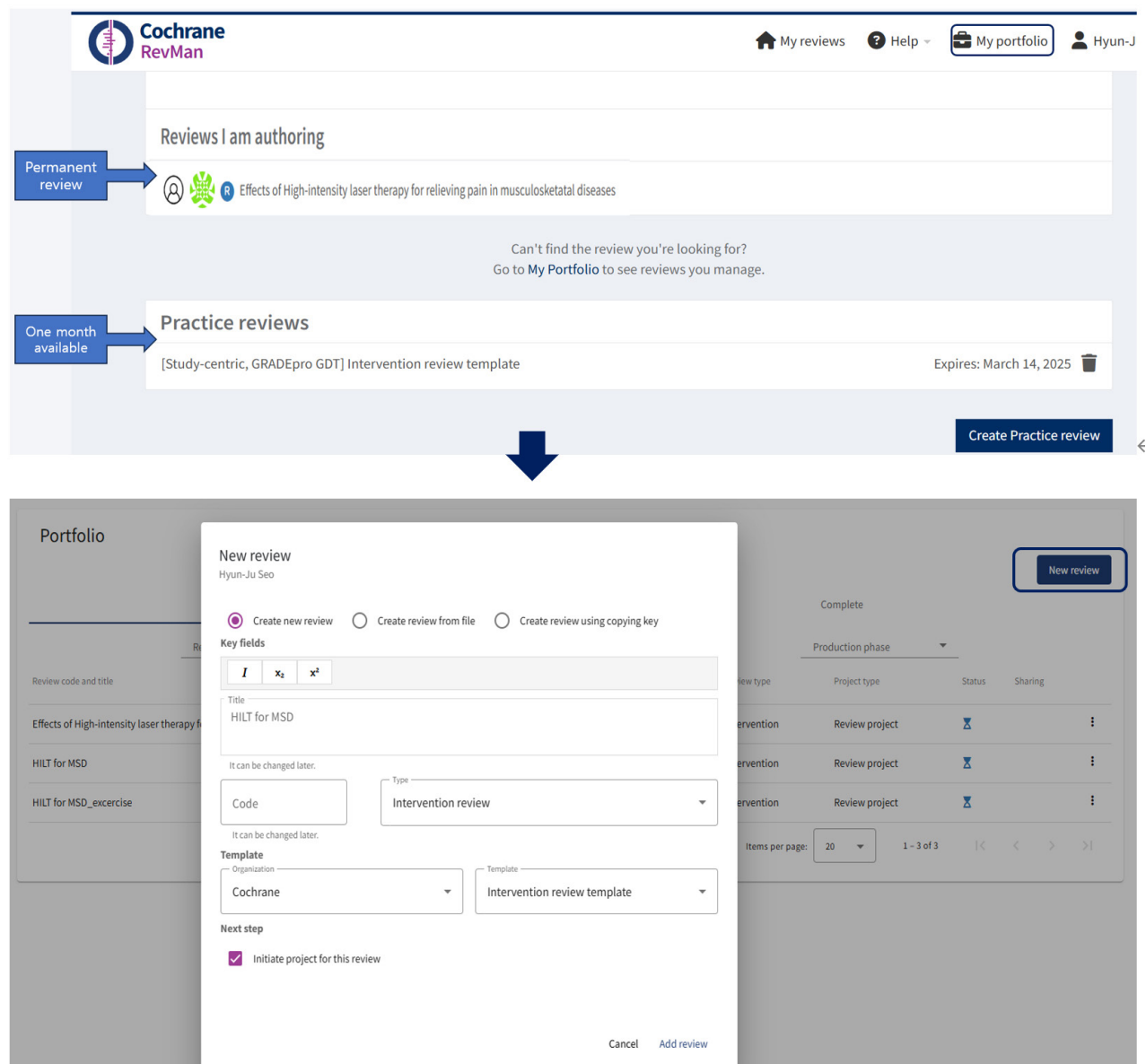


Fig. 1. Creation of my reviews, either practice review or permanent review, according to subscription.

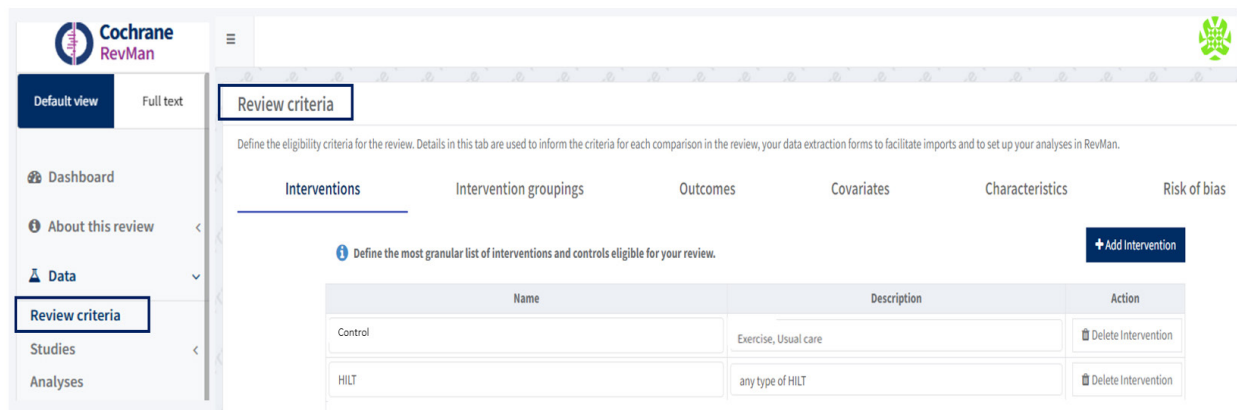


Fig. 2. Set up the review criteria, including interventions, intervention groupings, and outcomes.

Analyses

In RevMan, there are two approaches: manual input analyses or study-centric data analyses (Table 1). Manual input analysis is aligned with the previous RevMan 5 software, in which researchers manually input each study's data, prepared using a wide-form dataset. The characteristic of wide format is that all information pertaining to a single entity is contained within one row. If the outcome data type is binary, the event numbers and the total numbers in the result data in each arm should be included. For continuous outcome variables, the mean and standard deviation of each study arm are re-

quired to conduct manual input analysis in the RevMan Web version.

Study-centric data analyses are new data analytic ways introduced in the RevMan web version. According to Cochrane RevMan Web Knowledge base [12], study-centric data management constitutes an efficient approach to data handling in meta-analysis. By defining synthesis criteria and planned analyses in RevMan at the protocol stage, reviewers can extract data through standardized templates, using either arm-level data or contrast-level data with a long-form data format (Fig. 3). This allows for the subsequent import of

Table 1. Types of the Two Analytic Approaches in the RevMan web Version

	Manual input analyses	Study-centric data(automatic) analyses
Analyses without subgroups	☑	☑
Subgrouping by a characteristic of the included studies	☑	☑
Combining arms	☑ by using the calculator.	☑ define covariates and relevant categories in the Review criteria.
Splitting control arms	☑ by splitting the control arm	☑ only relevant when subgrouping by intervention is conducted.
Create analyses with contrast data	☑	☑
Create analyses with different types of specifications of interventions	☑	☑
Subgroup by the most granular interventions	☑	☑
Subgroup by variants of the outcome	☑	X
Subgroups within studies	☑	X

Reference: <https://documentation.cochrane.org/revman-kb/study-centric-data-management-117379417.html>

	A	B	C	D		A	B	C	D	E	F	G	H	I
1	Study	Arm	Description	Intervention	1	Study	Outcome	Data type	Arm	Sample size	Cases	Mean	SD	SE
2	Alayat 2014	Control		Control	2	Alayat 2014	Pain	Arm level	Control	24		3.71	1.3	
3	Alayat 2014	HILT		HILT	3	Alayat 2014	Pain	Arm level	HILT	28		2.64	1.25	
4	Alayat 2016	Control		Control	4	Alayat 2016	Pain	Arm level	Control	30		2.83	0.79	
5	Alayat 2016	HILT		HILT	5	Alayat 2016	Pain	Arm level	HILT	30		1.77	0.73	
6	Chen 2018	Control		Control	6	Chen 2018	Pain	Arm level	Control	31		2.03	1	
7	Chen 2018	HILT		HILT	7	Chen 2018	Pain	Arm level	HILT	32		1.18	0.91	
8	Kim 2015	Control		Control	8	Dundar 2015a	Pain	Arm level	Control	37		4.1	1.4	
9	Kim 2015	HILT		HILT	9	Dundar 2015a	Pain	Arm level	HILT	38		2.6	1.2	
10	Alayat 2014	Control		Control	10	Kim 2015	Pain	Arm level	Control	33		2.2	2.2	
11	Alayat 2014	HILT		HILT	11	Kim 2015	Pain	Arm level	HILT	33		2	2.2	
12	Dundar 2015a	Control		Control	12	Salli 2016	Pain	Arm level	Control	34		2.7	2.9	
13	Dundar 2015a	HILT		HILT	13	Salli 2016	Pain	Arm level	HILT	31		2.6	2.4	
14	Salli 2016	Control		Control	14	Alayat 2014	Adverse events	Arm level	Control	24	2			
15	Salli 2016	HILT		HILT	15	Alayat 2014	Adverse events	Arm level	HILT	28	4			
					16	Alayat 2016	Adverse events	Arm level	Control	30	7			
					17	Alayat 2016	Adverse events	Arm level	HILT	30	1			
					18	Chen 2018	Adverse events	Arm level	Control	31	7			
					19	Chen 2018	Adverse events	Arm level	HILT	32	6			
					20	Dundar 2015a	Adverse events	Arm level	Control	37	9			
					21	Dundar 2015a	Adverse events	Arm level	HILT	38	1			
					22	Salli 2016	Adverse events	Arm level	Control	38	1			
					23	Salli 2016	Adverse events	Arm level	HILT	40	1			

Fig. 3. Exemplar of study arms file and study results data file, prepared as arm-level data type in a long-form dataset.

study data with minimal procedural effort and the automatic population of the analyses. This process reduces dependence on manual data entry and minimizes the risk of error.

For this automatic analysis using study-centric data input, researchers need to prepare a long-form data format where each row represents a single observation of a single variable. Users can download data extraction templates to import all study data from <https://documentation.cochrane.org/revman-kb/data-extraction-templates-260702375.html>.

To conduct correct study-centric data analyses, users should consider the following points. First, users should prepare data extraction templates that are aligned exactly with the “Review criteria”. For example, suppose researchers input “Outcome” as an “adverse events” in the “Review criteria”. In that case, the Outcome variable of the standardized templates needs to be entered as “adverse events” rather than “adverse event”. Second, two data types might be used in the standardized templates of RevMan web version. The contrast level in the data type refers to the relative treatment effects (e.g., natural log risk ratio, $\ln(RR)$, or mean difference, along with standard error and 95% confidence intervals) across the trials. Whereas the arm-level data type indicates data for all study arms that are available (e.g., number of cases/events and total numbers for each group, or mean, standard deviation, and total numbers for each arm). In automatic analyses under “Data source”, users could choose to include a) only arm-level data, b) only contrast-level data, c) contrast- and arm-level data (preferring arm-level data where both exist), d) contrast- and arm-level data (preferring contrast-level data

where both exist), depending on their prepared data template from studies included in the meta-analysis [13].

Study-centric data (automatic) analysis composed of a long-form dataset

Researchers should plan how to perform meta-analyses during the protocol phase to enable automated analysis with study-centric data input. After creating the “Review criteria” aligned with standardized templates, users can import their results data for automatic analyses in Dashboard, and the analyses will be populated in one go. Finally, reviewers should review the analyses that RevMan has automatically created. When importing study data into the Dashboard, users select the file type to upload, which can be either a CSV file or a JSON file. Because downloaded standardized data extraction templates are CSV files, users carefully manage the file to import CSV files, not Excel files. Both the study arms and the study results data CSV file, previously prepared in a long-form dataset, are required to conduct a meta-analysis. When files contain inconsistent data with the Review criteria, validation issues occur. After users need to resolve potential validation errors, and then click “import study data” to complete the automatic analyses. Researchers go back to the analyses and find the forest plot in the Analyses (Fig. 4).

Manual input analysis using a wide-form dataset

To perform manual input analysis, reviewers need to enter arm-level data in “Study arms” and “Result data” as well as

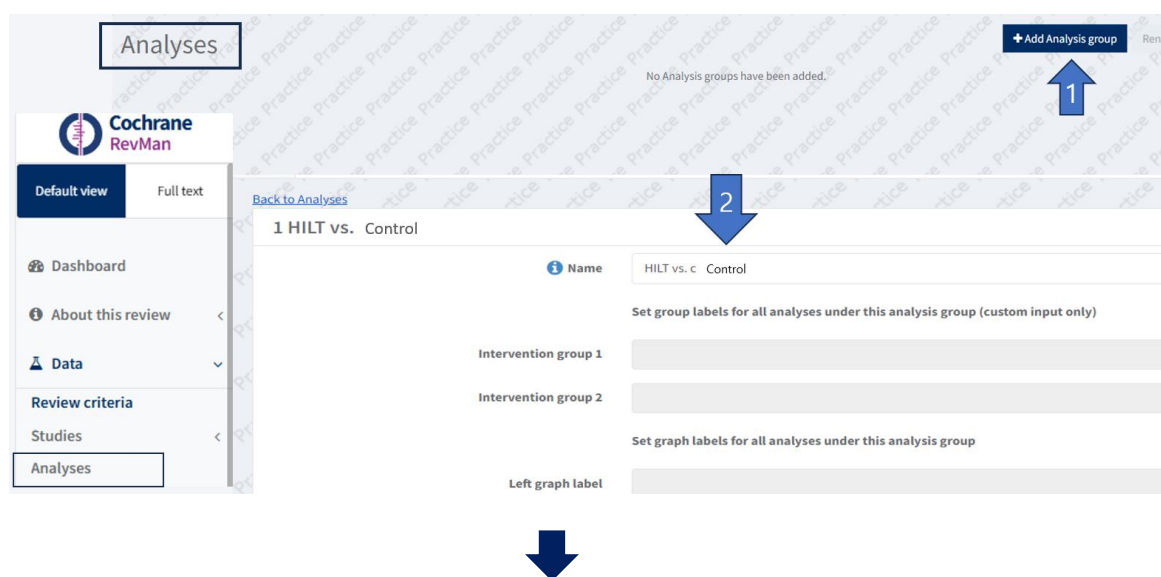


Fig. 4. Main process of study-centric data analysis in RevMan Web. (Continued to the next page)

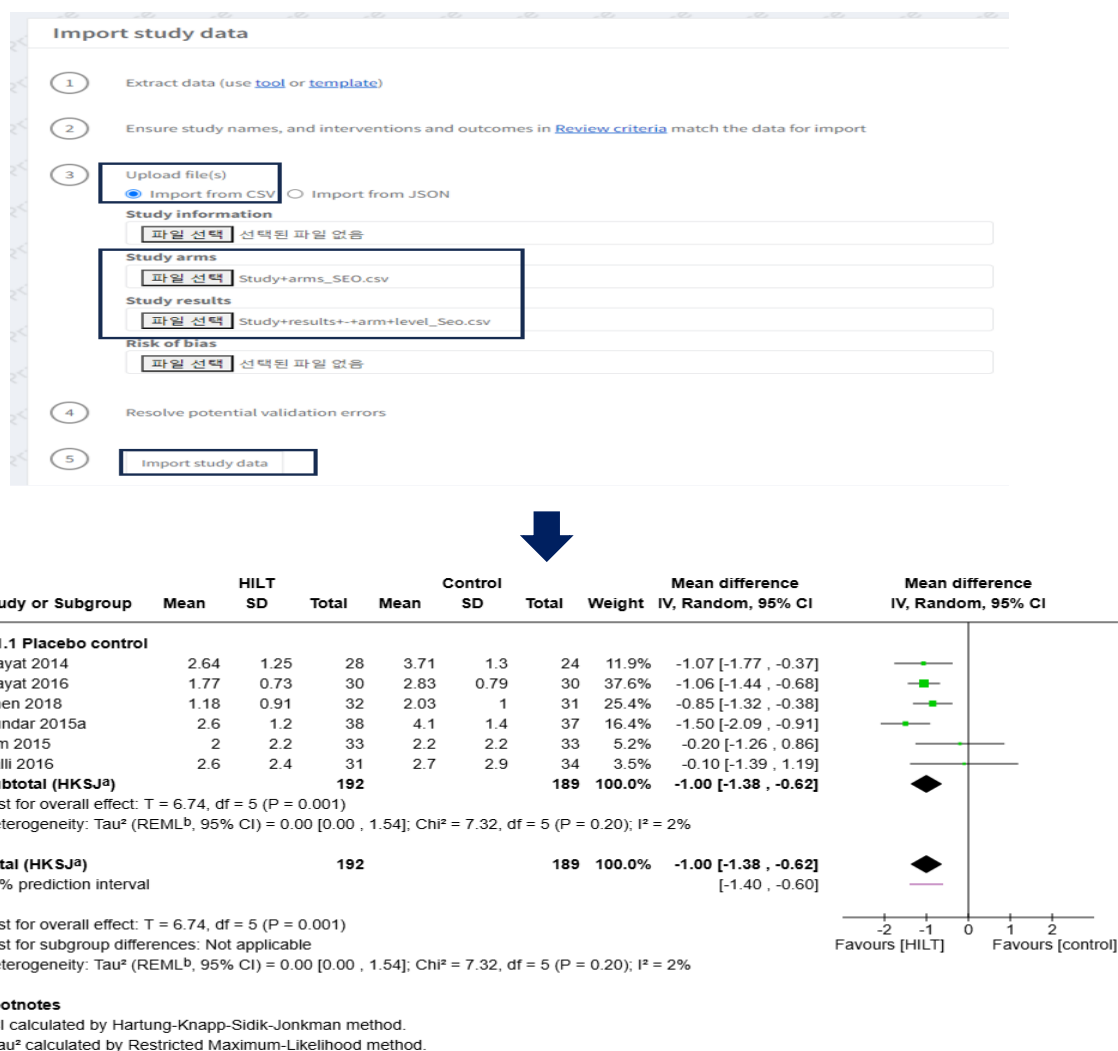


Fig. 4. Continued.

new study information such as General after clicking “add study” in “included” of “Studies” in “Data” section (Fig. 5). Users can select “Add data row” to add relevant studies from the list of included studies. In manual analysis, like the previous RevMan 5 software, users can enter data by typing it manually into the table cells or pasting data in tabular form from a wide-form dataset in an Excel file.

To create funnel plot of forest plot, users click “Figures” in left column of Default view, and click “Add Figure” then scroll down in “Figure type” as funnel plot, and select the analysis (Fig. 6).

Conclusion

The recently updated RevMan web version provides us-

er-friendly software that enables researchers to conduct basic meta-analyses using either automatic or manual input analysis. Additionally, RevMan web is available for the implementation of up-to-date theoretical knowledge of meta-analyses, including the REML method to estimate heterogeneity variance of random-effects meta-analyses, the HKSJ method to reflect the uncertainty of the pooled estimates, and the prediction interval in a random effects model to explore the true treatment effects in a future study. However, because it does not support more advanced analytical methods, such as meta-regression or network meta-analysis, and requires an annual software subscription, alternative software programs, such as R Studio with free access, might be considered when conducting complex analyses.

Analyses

1 HILT vs. Control

2 Manual_HILT vs. Controls

Table 1. Effects of HILT for MSD: pain reduction

subgroup	study id	mean_exp	sd_exp	n_exp	mean_con	sd_con	n_con
placebo	Alayat et al., 2014	2.64	1.25	28	3.71	1.3	24
placebo	Alayat et al., 2016	1.77	0.73	30	2.83	0.79	30
placebo	Chen et al., 2018	1.18	0.91	32	2.03	1	31
placebo	Dundar et al., 2015a	2.6	1.2	38	4.1	1.4	37
placebo	Kim et al., 2015	2	2.2	33	2.2	2.2	33

Study arms

Alayat et al.

Study ID: Alayat et al.

Year: 2016

Data source:

- ☒ Published data only (unpublished not sought)
- ☐ Published and unpublished data
- ☐ Unpublished data only
- ☐ Published data only (unpublished sought but not used)

Add Analysis

Create an analysis based on synthesis criteria (Automatic) or enter data manually (Manual):

☐ **Automatic**
Select outcome and interventions. RevMan will automatically include all study data for the selected criteria in the analysis.

☒ **Manual**
Select studies. You will need to enter the study data specifically for this analysis and data cannot be re-used (only duplicated).

OK Cancel

Fig. 5. Manual input analyses prepared as arm arm-level data type.

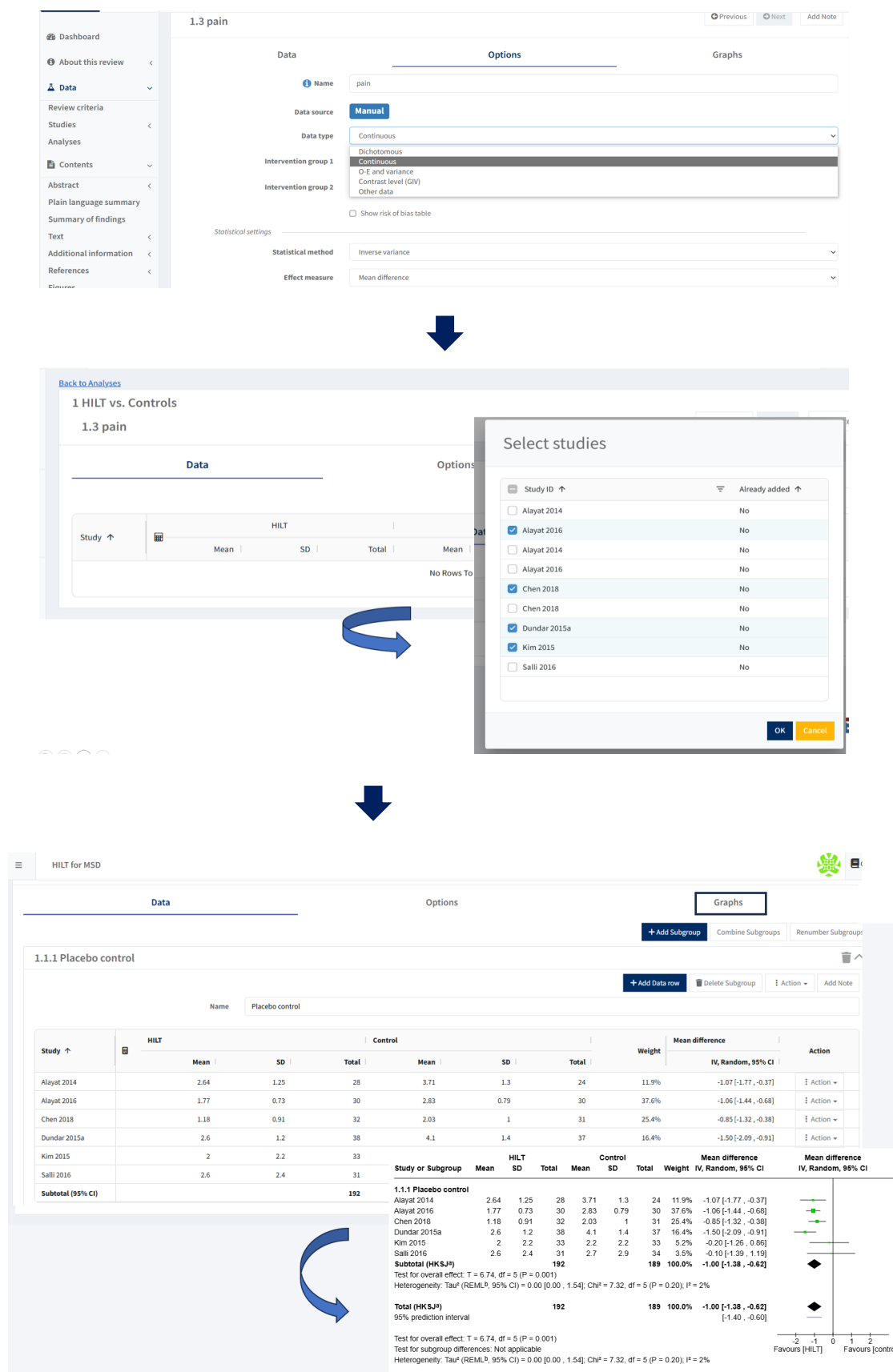


Fig. 5. Continued.

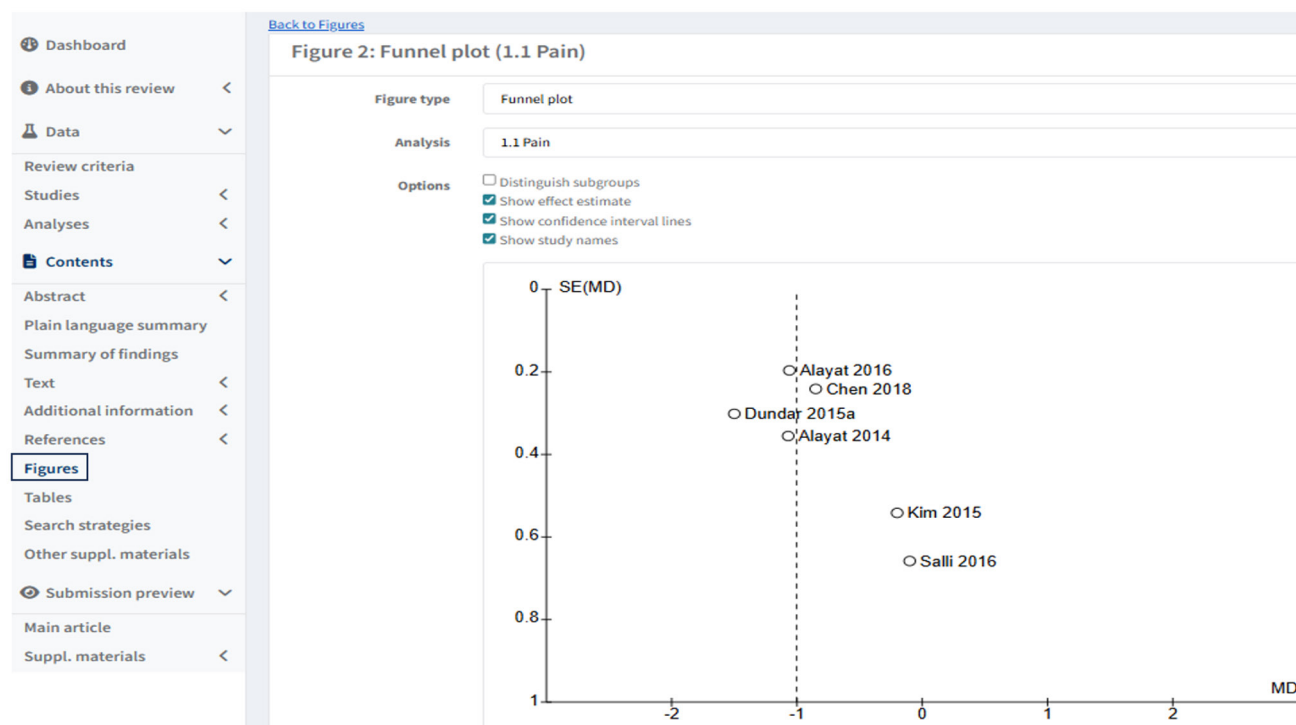


Fig. 6. Creating a Funnel plot of a forest plot in Figures

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Data Availability Statement

All data generated or analyzed during this study are included in this published article.

Ethics Approval and Consent to Participate

Not applicable.

Authors Contributions

Study conception, Design acquisition, Drafting and critical revision of the manuscript - HJS.

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The use of evidence in decision-making in the context of Korean healthcare: a review

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This paper examines some examples of not well integrating evidence into healthcare decision-making within the Republic of Korea, a nation characterized by a rapidly evolving and financially strained healthcare system. The review introduces various conceptual frameworks of evidence-based practice, including Evidence-Based Medicine (EBM), Evidence-Based Public Health (EBPH), and Evidence-Based Health Policy (EBHP), alongside a nuanced typology of scientific (context-free and context-sensitive) and colloquial evidence. Through brief literature reviews, the paper identifies significant barriers and crucial facilitators to effective evidence utilization. These include deficiencies in research infrastructure, accessibility gaps, the influence of political and value-based considerations, and the pervasive challenge of "decision-based evidence making." The report concludes by proposing actionable recommendations aimed at strengthening the evidence ecosystem, fostering deliberative processes, enhancing Health Technology Assessment (HTA) integration, and cultivating a robust culture of evidence-informed policy-making in Korea.

Keywords: Evidence-based medicine; Decision making; Health policy; Public health; Policy making

Introduction

Global landscape of evidence-based healthcare and policy

The global healthcare landscape is undergoing a profound transformation, marked by a decisive shift towards evidence-based practices (EBP). This paradigm represents a departure from traditional decision-making, which often relied on anecdotal experience, intuition, or opinion. The movement towards EBP is not merely a fleeting trend but a systemic response to mounting pressures within healthcare systems worldwide. Escalating healthcare expenditures, as observed in Korea [1], coupled with the increasing complexity of modern medical science, necessitate more efficient and effective allocation of finite resources. EBP offers a structured

framework to achieve this by minimizing the adoption of ineffective interventions and maximizing the impact of beneficial ones. This global movement provides a crucial benchmark against which the progress and challenges of evidence utilization within the Korean healthcare system can be critically assessed.

Significance of evidence in healthcare decision-making

Evidence plays a pivotal role in ensuring the efficacy, safety, cost-effectiveness, and equitable distribution of healthcare interventions and policies. Robust, systematically generated evidence directly correlates with improved patient outcomes and contributes significantly to the long-term sustainability of health systems. The importance of evidence extends be-

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yond mere clinical efficacy to encompass broader societal values, such as equity and justice, which are sometimes overlooked in frameworks driven purely by efficiency. For evidence to be truly impactful in policy, it must be multi-dimensional, integrating not only rigorous scientific data but also social determinants of health, population-level needs, ethical considerations, and patient values. The increasing emphasis on value-based appraisal methods in decision-making processes implicitly supports this broader, more holistic understanding of evidence [2].

Overview of the Korean healthcare system

The Republic of Korea operates a universal National Health Insurance (NHI) system, which provides comprehensive coverage to 97% of its population. The remaining 3% of low-income individuals are covered by a tax-funded Medical Aid Program. Over recent decades, the Korean healthcare system has experienced rapid development, achieving impressive health outcomes. However, this growth has also presented inherent challenges, particularly concerning financial sustainability and equitable access. Understanding the structure, achievements, and ongoing challenges of this system is essential for contextualizing the subsequent analysis of evidence utilization in Korean healthcare decision-making.

Purpose and structure of the review

This review aims to examine the current state of evidence utilization in Korean healthcare decision-making. It seeks to identify prevailing challenges and emerging opportunities, ultimately proposing actionable recommendations for strengthening evidence-informed policy and practice. The paper is structured to first outline the conceptual frameworks of evidence, followed by an analysis of current practices through specific case studies. A comprehensive discussion of the identified barriers and facilitators to evidence utilization will then be presented, concluding with a set of targeted recommendations.

Conceptual Frameworks of Evidence in Healthcare Decision-Making

Defining evidence-based medicine, public health, and health policy

The concept of evidence-based practice has evolved across various domains within healthcare, leading to distinct yet interconnected definitions:

- **Evidence-Based Medicine (EBM):** EBM is fundamentally a systematic approach where healthcare professionals integrate the best available scientific evidence from clinical

research with their individual clinical expertise and the patient's unique values and preferences. This integration is crucial for making informed decisions about the care of individual patients. It emphasizes a conscientious, explicit, and judicious use of current best evidence [3].

- **Evidence-Based Public Health (EBPH):** EBPH extends the principles of EBM to the broader field of public health. It involves integrating science-based interventions with community preferences, practitioner expertise, and the specific characteristics, needs, values, and preferences of the target population [4]. A key distinction is that randomized clinical trials (RCTs), while the gold standard in EBM, are not always directly applicable or feasible for investigating the complex, population-level problems inherent in public health [5].
- **Evidence-Based Health Policy (EBHP):** EBHP represents a further evolution, focusing on the utilization of research findings to inform and support policy decisions at a systemic level. This often involves comprehensive research methods, including RCTs, but critically relies on good data, strong analytical skills, and robust political support for the integration of scientific information into policy formulation [6].

This conceptual progression from EBM to EBPH and EBHP signifies a broadening understanding of "evidence" beyond the confines of clinical trials. EBM, rooted in clinical epidemiology and emphasizing RCTs [7], forms a foundational concept. However, a strict application of EBM principles to public health or policy contexts proves challenging due to inherent differences in interventions, outcomes, and target populations [5]. EBPH and EBHP explicitly recognize the need for diverse types of evidence, such as observational studies, quasi-experiment, and economic evaluations for public health [8]. Furthermore, these broader frameworks acknowledge the significant influence of non-scientific factors, including political considerations and societal values [9]. This conceptual evolution underscores the adaptive nature of evidence-based practices, which must be tailored to fit the specific nuances of different decision-making environments.

Components of evidence-based practice

David Sackett's seminal definition of evidence-based medicine posits that effective practice requires the integration of three core components (Sackett's triad): the best available external clinical evidence from systematic research, individual clinical expertise, and patient values and preferences [3]. This triad underscores that evidence alone is insufficient for optimal decision-making.

The explicit inclusion of "clinical expertise" and "patient

values and preferences" within Sackett's framework is a crucial distinction. It directly refutes a simplistic interpretation of EBP as merely the mechanical application of research findings. This framework highlights the indispensable human element—the nuanced judgment of experienced clinicians and the unique circumstances and desires of patients—which introduces inherent subjectivity and context into the decision-making process, making it far more complex than a purely scientific exercise. This also establishes a conceptual link to the need for deliberative processes that can effectively integrate these diverse, often qualitative, perspectives alongside quantitative evidence.

Typology of evidence: scientific and colloquial evidence

Building on the work of Lomas et al. (2005), evidence in healthcare decision-making can be broadly categorized into scientific evidence and colloquial evidence [10,11].

Scientific Evidence:

Context-Free: This type of evidence is explicit, systematic, and replicable, typically generated through controlled experiments like randomized controlled trials (RCTs). It focuses on the general clinical potential, efficacy, and safety of interventions, aiming for universal applicability.

Context-Sensitive: While still systematic, this evidence is collected in ways more relevant to the specific real-world context in which a technology or intervention is to be used. It addresses aspects such as implementation feasibility, organizational capacity, economic implications (e.g., cost-effectiveness analyses), and ethical considerations within a particular setting.

Colloquial Evidence: This category encompasses information that is neither strictly scientific nor systematically collected, yet it is frequently the only available input for certain issues. It includes expert testimony, professional opinion, political judgment, values, practical considerations (such as

resource availability), established habits or traditions, and the interests and views of specific groups (e.g., lobbyists, pressure groups). Policy-relevant documents not published in peer-reviewed journals also fall under this category [12].

Ultimately, effective evidence-informed health policy making is best supported by a judicious combination of these three types of evidence, alongside other influencing factors. The explicit recognition and stated prevalence of colloquial evidence in policy decision-making is a critical observation. It highlights the inherent political and pragmatic realities that often influence, and sometimes supersede, purely scientific considerations. This is not necessarily a negative aspect if these diverse forms of evidence are integrated through transparent, structured, and deliberative processes. Lomas et al. make a crucial observation that "the use of colloquial evidence prevails among decision-makers" [10]. This is an important point because it directly challenges the notion of policy as a purely rational, scientific exercise. It acknowledges that political judgment, the influence of various stakeholders, and practical resource constraints are always present and significantly impact decisions. The challenge, therefore, is not to eliminate colloquial evidence, which is often unavoidable and valuable for contextual understanding, but to integrate it systematically and transparently with scientific evidence [13]. This also establishes a direct link to the concept of "decision-based evidence making," where evidence might be strategically employed to support a pre-determined policy direction, rather than genuinely inform or make the decision.

Table 1 provides a clear, structured overview of the different types of evidence discussed in these conceptual frameworks, making complex distinctions easily comprehensible. It visually demonstrates that the concept of "evidence" in health policy is not narrowly confined to highly controlled scientific studies like RCTs, but encompasses a much wider array of information, including qualitative data, experiential knowledge, and socio-political considerations. This broad understanding is crucial for appreciating the challenges

Table 1. Typology of Evidence in Healthcare Decision-Making

Type of evidence	Key characteristics	Primary source examples	Role in decision-making
Scientific (Context-free)	Explicit, Systematic, Replicable; Universal applicability	Randomized Controlled Trials (RCTs), Systematic reviews, Meta-analyses	Establishes general efficacy/safety of interventions
Scientific (Context-sensitive)	Adapted to local context; Addresses implementation, economics, ethics within a setting	Cost-effectiveness analyses, Real-world data, Implementation studies	Informs practical application, feasibility, and local impact
Colloquial	Non-systematic, Reflects values/experience; Often the only available input	Expert testimony, Professional opinion, Political judgment, Policy reports, Stakeholder views, Patient experiences	Supplements/refutes scientific evidence; Integrates societal values and practical constraints

and opportunities inherent in genuine evidence-informed decision-making. By clearly outlining the distinct roles and contributions of each evidence type, the table implicitly sets the stage for a deeper discussion on how these varied forms of evidence must be thoughtfully integrated and balanced for effective and legitimate policy-making, rather than relying on a singular, narrow definition of "best evidence."

The role of health technology assessment (hta) in evidence generation

Health Technology Assessment (HTA) serves as a vital policy tool designed to provide evidence-based information regarding health technologies. It achieves this by conducting comprehensive evaluations of their clinical efficacy, economic implications, social impact, ethical considerations, and legal ramifications. HTA plays a crucial role in reducing uncertainties in decision-making and facilitating systematic and transparent choices across various levels of the healthcare system, including national government, system-wide prioritization, and local budget allocation [2].

HTA functions as a crucial bridge between diverse forms of evidence (both scientific and colloquial) and actual policy decisions, particularly concerning resource allocation and the adoption of new technologies. Its inherently multi-faceted evaluation framework implicitly acknowledges the complex nature of healthcare choices, which extend far beyond mere clinical effectiveness. The comprehensive scope of HTA, encompassing clinical, economic, social, ethical, and legal dimensions, signifies its design to integrate a wide array of evidence types. It moves beyond the narrow question of "what works" to address "what works, for whom, at what cost, and with what broader societal implications." This holistic approach positions HTA as a practical embodiment of evidence-informed decision-making, transcending a purely EBM focus to embrace a broader EBHP perspective. The identified barriers to ethical evaluation within HTA processes highlight specific areas where HTA's full potential in integrating diverse evidence and values might currently be under-realized [2].

Current Landscape of Evidence Use in Korean Healthcare Policy

Healthcare expenditure trends and sustainability challenges in Korea

Korea's healthcare spending has demonstrated exceptionally rapid growth, recording the fastest pace among OECD countries. From 2010 to 2019, total health expenditure nearly doubled, with an average annual surge of 8%, significantly

surpassing the OECD average annual increase of 3.6% [14]. The ratio of health expenses to GDP in Korea rose from 6.5% in 2014 to 8% in 2019, a substantial 1.5 percentage point increase, starkly contrasting with the mere 0.1 percentage point increase in the OECD average during the same period [15].

This upward trend is projected to continue, with health care spending expected to absorb 15% of GDP by 2065. This is primarily driven by a rapidly aging population, where the proportion of those aged 65 and older is projected to increase from 11% in 2010 to 42.5% by 2065, and increased healthcare utilization. While population aging contributes modestly to per-person spending growth, non-demographic factors such as economic growth, the expansion of National Health Insurance (NHI) coverage, and increased provision and utilization of health care services are identified as key drivers [14].

Korea also exhibits a high proportion of out-of-pocket (OOP) payments, accounting for 29% of total health expenditures in 2021. This places it as the 5th highest among OECD countries and 11 percentage points above the OECD average. This significant reliance on OOP payments contributes substantially to final household consumption (6.1% in 2021, the highest among OECD countries) and leads to a high incidence of catastrophic health expenditures, particularly for low-income households (7.5% in 2016 faced OOP payments exceeding 40% of their income, compared to an OECD average of over 5%). The high OOP burden and existing gaps in NHI coverage have led to a significant increase in voluntary private health insurance, rising from 51% of the population in 2011 to 72% in 2021. In response, the Korean government launched an ambitious plan in 2017 to expand NHI coverage to include expensive services (e.g., MRI, ultrasound scans) and reduce co-payment rates, aiming to increase the public sector's share of healthcare spending to 70% by 2022 (it reached 62.3% in 2021, up from 58.9% in 2017) [16].

Korea's uniquely rapid healthcare expenditure growth, coupled with a disproportionately high reliance on out-of-pocket payments and a lower public share of spending compared to OECD averages, indicates a healthcare system under significant and growing financial strain. This escalating financial pressure creates an urgent and compelling imperative for robust evidence-informed decision-making to ensure both the long-term sustainability and equitable access within the system. The prevalence of high out-of-pocket payments directly translates into significant barriers to access and exacerbates inequities, particularly for vulnerable populations, leading to "catastrophic health expenditures". This dire financial context elevates evidence-based resource allocation from a mere best practice to an absolute critical necessity for the system's long-term fiscal viability and adherence to prin-

ciples of social justice. The governmental response, such as the expansion of NHI coverage, itself represents a major policy intervention that demands rigorous evidence to evaluate its effectiveness, efficiency, and overall sustainability [16].

Case studies: evidence use in Korean healthcare policy

Medical school enrollment quota controversy

The controversy surrounding the medical school enrollment quota in South Korea provides a compelling illustration of the complexities of evidence utilization in high-stakes policy decisions. The government has advocated for a significant increase of 2,000 medical school seats, citing a projected shortage of 10,000 doctors by 2035, with an additional 5,000 needed to address regional imbalances [17].

However, a critical aspect of this controversy is the disagreement between the government and the very researchers whose reports were used to justify this expansion. Prominent academics advocate for a more gradual increase, suggesting, for instance, 500-1,000 seats annually for five years. They also project a doctor surplus after 2045-2050, expressing regret that the government did not consider a more phased approach. This situation exemplifies the profound tension between scientific evidence, political judgment, and entrenched stakeholder interests in high-stakes health policy decisions. The disagreement extends beyond the raw data to encompass its interpretation, the assumptions underpinning future projections, and, crucially, the process by which decisions are ultimately reached. This strongly suggests the occurrence of "decision-based evidence making," where evidence is selectively utilized to legitimize or "support" a pre-determined policy outcome rather than genuinely inform or make the decision [18].

The controversy has escalated into a "strong vs. strong" confrontation between the government and medical organizations. To resolve this impasse, the researchers have proposed parliamentary mediation or the formation of a social consultative body. They have also suggested the establishment of a specialized agency, similar to those in the United States and Japan, to provide objective evidence for doctor supply projections and other policy decisions, thereby fostering trust and depoliticizing contentious issues. The medical school quota debate serves as a compelling real-world illustration of how evidence becomes a battleground in a highly politicized policy environment. The government's assertion of a specific, large increase, despite the nuanced and more cautious recommendations from the very researchers whose work they cite, strongly indicates that the "evidence" is being used to support a policy that has already been decided. This

highlights a fundamental breakdown in the evidence-informed decision-making process. The researchers' call for parliamentary mediation or an independent consultative body underscores the absence of a trusted, transparent, and deliberative mechanism capable of integrating diverse scientific interpretations, political imperatives, and stakeholder concerns in a legitimate and effective manner. This points to a systemic issue in governance and trust.

Management of non-covered medical services

The management of non-covered medical services by National Health Insurance Service in Korea presents another complex challenge for evidence-informed decision-making. These services are considered essential for providing patient choice, managing the efficiency of health insurance finances, and accommodating the rapid emergence of new medical technologies. Despite their perceived necessity, concerns persist regarding the weak evidence base for the efficacy or necessity of some non-covered medical procedures.

Recent amendments to the Medical Act (Article 45-2) now mandate healthcare institutions to report not only the prices but also the standards and detailed clinical records of non-covered services. This new requirement imposes a significant administrative burden on medical institutions, leading to concerns about excessive government control over pricing, quantity, and quality of these services. Critics argue that such government control over non-covered services fundamentally infringes upon patients' basic rights, asserting that these services are largely market-driven and subject to continuous evaluation by consumers through various platforms [19].

The current health insurance system faces inherent dilemmas: providing the "best" medical services to all patients inevitably drives up costs; fully integrating all services into covered insurance benefits increases overall utilization; and accommodating diverse patient demands can lead to the proliferation of arbitrary non-covered services. Furthermore, structural issues within the Korean healthcare system, such as "unbalanced compensation for essential medical services" and "high civil/criminal burden" on providers, contribute to an "imbalance in personnel supply and demand" and a "concentration in private practice and non-covered services" [20]. This suggests that economic incentives may be driving practice patterns away from evidence-based priorities in essential care.

The persistent challenges surrounding non-covered services reveal a fundamental tension within the Korean healthcare system: balancing market principles and patient autonomy with public health objectives and the demand for evidence-based

value. The lack of robust evidence for certain services, combined with the administrative burdens and concerns about potential government overreach, highlights the profound difficulty of applying evidence-informed decision-making in areas where strong economic incentives and individual patient demand significantly influence practice patterns. The argument that non-covered services are "market-driven" and represent a "basic right" directly conflicts with the core EBP principle of ensuring efficacy, safety, and value for money. The administrative burden imposed by new regulations and the concerns about government control highlight the practical difficulties of implementing evidence-based regulations in a system with substantial private sector involvement. Critically, the link between "unbalanced compensation for essential medical services" and the concentration of providers towards non-covered services strongly suggests a systemic issue where economic incentives may be inadvertently driving clinical practice patterns away from evidence-based priorities in essential care, thereby creating a disincentive for both evidence generation and adherence in these lucrative, yet potentially unproven, areas.

Barriers and Facilitators to Evidence-Informed Decision-Making in Korea

Identified barriers to evidence utilization

The effective utilization of evidence in Korean healthcare decision-making is impeded by a multifaceted array of barriers:

- **Lack of Research Evidence & Quality:** A significant challenge is the insufficient research period and funding allocated to health policy studies, which often compromises the quality and reliability of existing research. There is also a notable dearth of timely, context-specific domestic research, making it challenging to apply findings directly to the unique Korean context [9].
- **Accessibility and Dissemination Gaps:** Policymakers frequently report low accessibility to relevant research findings. Furthermore, there is a critical absence of dedicated organizations and effective programs specifically tasked with the systematic dissemination of research in Korea [9].
- **Translational Challenges:** Difficulties exist in effectively translating the complex results of ethical analyses, often embedded within Health Technology Assessments, into practical, actionable knowledge that is readily useful for decision-makers [2].
- **Organizational and Resource Constraints:** Decision-making bodies often suffer from limited ethical knowledge and expertise among their staff, coupled with insufficient time and financial resources to engage deeply

with evidence and conduct thorough appraisals [2].

- **Methodological Complexity:** Within Health Technology Assessment (HTA), the scarcity, heterogeneity, and inherent complexity of ethical analysis methods pose significant hurdles to their consistent and widespread application [2].
- **Policy-Research Disconnect:** A critical criticism of evidence-based policy in Korea is that research evidence is frequently used to rationalize or legitimize specific policies that have already been decided, rather than genuinely informing the decision-making process from the outset [9]. This phenomenon, often termed "decision-based evidence making," creates a fundamental gap between policy needs and research output, where international evidence might be generalizable but relevant domestic research is conspicuously lacking [21].
- **Value and Equity Concerns:** There is an observed overemphasis on efficiency within the framework of research evidence, which makes it challenging to adequately reflect and integrate crucial societal values such as equity and justice into policy decisions [9].
- **Generalizability Issues:** Research, particularly randomized controlled trials (RCTs), may not always be directly relevant for all treatment situations or sufficiently generalizable to diverse patient populations or individuals with complex multi-morbidities, limiting their direct applicability in real-world clinical and policy settings [22].
- **Lag in Application:** A significant time lag often exists between the completion of RCTs, the publication of their results, and the proper, widespread application of these findings in practice [22].
- **Confirmation Bias:** Practitioners and policymakers lacking sufficient skills in seeking and critically appraising evidence are prone to confirmation bias, selectively interpreting evidence that supports their pre-existing beliefs or experiences [23].

The identified barriers collectively point to a systemic issue where the supply of relevant, high-quality evidence is insufficient, its translation and accessibility are poor, and the demand for it is often distorted by political and value-based considerations. This complex interplay creates a fertile ground for "decision-based evidence making" and severely limits the true impact and integrity of evidence-informed decision-making in Korean healthcare. The confluence of various barriers creates a deeply entrenched and complex web of challenges. It is not merely a quantitative lack of evidence, but fundamental deficiencies across the entire evidence ecosystem: from its production (e.g., inadequate funding, questionable quality), to its dissemination (e.g., poor acces-

sibility, absence of dedicated intermediary bodies), to its translation (e.g., difficulties in converting complex research into policy-relevant knowledge), and ultimately, to its utilization (e.g., often for legitimization rather than genuine decision-shaping). The critique that evidence is presented as "value-neutral" but inherently emphasizes efficiency is particularly profound, revealing a fundamental philosophical tension within evidence-informed decision-making when applied to real-world policy contexts where values like equity and justice are equally, if not more, paramount.

Identified facilitators for evidence utilization

Despite the challenges, several factors can facilitate the integration of evidence into healthcare decision-making in Korea:

- **Improved Research Support:** A critical facilitator is the provision of sufficient research period and funding, alongside concerted efforts to enhance the overall quality and reliability of health policy research [9].
- **Enhanced Accessibility:** Improving the accessibility of timely and context-specific domestic research findings to policymakers is crucial for their effective utilization [9].
- **Value-Based Appraisal Methods:** The adoption and systematic usage of appraisal methods that explicitly integrate societal values into the evidence evaluation process can significantly facilitate utilization, ensuring that decisions reflect broader societal goals beyond mere efficiency [2].
- **Stakeholder and Public Engagement:** Active involvement of diverse stakeholders and the broader public throughout the decision-making process is identified as a key facilitator. This recognizes their invaluable role in contributing "colloquial evidence" (e.g., lived experiences, community preferences) and thereby enhancing the legitimacy and public acceptance of policies [2].
- **Practice Guidelines & Ethical Expertise:** The enhancement of existing practice guidelines and the cultivation of robust ethical expertise within decision-making bodies are important facilitators, providing clear frameworks for evidence application and ethical consideration [2].
- **Educational Interventions:** Implementing targeted educational interventions and ongoing training programs for both practitioners and policymakers on evidence appraisal, critical thinking, and the nuances of different evidence types can significantly improve utilization and foster a more evidence-aware workforce [2].
- **Policymaker Demand:** A strong, explicit demand for evidence from policymakers themselves is a potent facilitator, signaling institutional commitment to evidence-informed approaches and driving systemic change [2].

- **Deliberative Processes:** The strategic utilization of deliberative processes that enable the negotiation of competing viewpoints, the integration of scientific opinion, and the thoughtful consideration of ethical and values-based dilemmas can significantly enhance evidence use and lead to more robust and accepted policy outcomes [24, 25].

The identified facilitators highlight that strengthening evidence-informed decision-making necessitates a multi-pronged and integrated approach. This approach must simultaneously address both the supply side (ensuring the quality, relevance, and accessibility of evidence) and the demand side (cultivating policymaker engagement, capacity, and willingness to use evidence). Crucially, it emphasizes the pivotal role of deliberative processes in legitimately integrating diverse forms of evidence and often conflicting values. The consistent emphasis on "value-based appraisal methods" and "stakeholder and public engagement" is particularly noteworthy [2]. This reinforces the understanding that effective evidence-informed decision-making is not solely about scientific rigor but also about achieving democratic legitimacy and social acceptance of policies. Deliberative processes are explicitly presented as a structured means to achieve this complex integration of diverse evidence and values, suggesting a necessary evolution from a purely technocratic view of evidence use to one that actively embraces complexity, pluralism, and public participation [24].

The challenge of "decision-based evidence making"

A critical concept to address is "decision-based evidence making" (DBEM), which stands in stark contrast to genuine evidence-based decision-making. In DBEM, evidence is primarily gathered, or even modified, for the sole purpose of legitimizing a decision that has already been made [18]. This phenomenon fundamentally transforms evidence from a tool for objective discovery and optimal choice into a mere rhetorical or political device, thereby undermining public trust and potentially leading to suboptimal, biased, or even harmful policy outcomes. This practice is particularly pertinent in the context of the Korean medical school enrollment quota controversy, where researchers' nuanced findings appear to have been selectively used to bolster a pre-determined government policy [17].

Evidence can serve three distinct roles in decision-making: to *make* a decision (an algorithmic, data-driven approach), to *inform* a decision (combining hard facts with qualitative inputs), or to *support* a decision (lending legitimacy to a pre-existing choice) [18]. DBEM falls squarely into this "support" category, where evidence functions largely as a

symbolic tool rather than a genuine shaper of outcomes. This practice can fundamentally subvert the ideal evidence-based process, particularly when subordinates or managers feel compelled to shape or present evidence in a way that aligns with the perceived expectations of higher-level leaders. The prevalence of DBEM in practice represents a significant and insidious threat to the integrity and effectiveness of true evidence-informed decision-making. It fundamentally transforms evidence from a tool for objective discovery and optimal choice into a mere rhetorical or political device, thereby undermining public trust and potentially leading to suboptimal, biased, or even harmful policy outcomes. The concept of DBEM provides a crucial understanding of why evidence might fail to be effectively utilized, even when it is readily available. This is not merely a technical problem of data availability or analytical capacity, but a deeply ingrained behavioral and political phenomenon within organizations and governments. Its direct connection to the Korean context, particularly the medical school quota debate where the government's specific numerical target seemed to precede and then selectively utilize research findings, strongly suggests DBEM at play. Recognizing and explicitly naming DBEM is essential for developing effective strategies that promote genuine evidence integration and critical appraisal, rather than merely facilitating the legitimization of pre-existing agendas. It shifts the focus from "what evidence is available" to "how is

evidence *actually used* and *why*?"

Table 2 provides a structured, comprehensive overview of the multifaceted challenges and opportunities for evidence-informed decision-making in Korea, integrating both general EBP literature and specific findings from the Korean context. A clear and concise summary of the key challenges and their corresponding potential solutions serves as a direct, actionable input for the subsequent recommendations section, making the report highly practical for policymakers and researchers seeking to identify and prioritize areas for intervention to improve evidence utilization.

Recommendations for Strengthening Evidence Use in Korean Healthcare

Based on the analysis of conceptual frameworks, current practices, and identified barriers and facilitators, the following recommendations are proposed to strengthen evidence-informed decision-making in Korean healthcare:

Enhancing research infrastructure and accessibility

A robust evidence ecosystem fundamentally begins with the foundational elements of research production and accessibility. Without a consistent supply of high-quality, relevant, and easily discoverable evidence, any subsequent efforts to promote evidence-informed decision-making will be inher-

Table 2. Key Challenges and Facilitators for Evidence Use in Korean Healthcare Policy

Category	Specific barriers	Specific facilitators
Evidence production	Insufficient research period and funding; Low quality and reliability of research; Dearth of timely, context-specific domestic research	Sufficient research period and funding; Enhanced quality and reliability of research; Focus on context-specific domestic research
Evidence dissemination & accessibility	Low accessibility to research findings for policymakers; Absence of dedicated dissemination organizations/programs	Establishment of dedicated dissemination organizations/programs; Enhanced accessibility of findings for policymakers
Translational capacity	Difficulties translating complex analysis results into actionable knowledge	Simplification of methodology; Development of practical good practice guidelines
Organizational & resource constraints	Limited knowledge and expertise among staff; Insufficient time and financial resources for evidence engagement	Building internal capacity for analyses; Provision of adequate time and resources
Policy-research interface	Evidence used for rationalization/legitimization of pre-decided policies ("Decision-Based Evidence Making"); Gap between policy needs and research output	Policymaker demand for evidence; Establishment of independent expert bodies (e.g., for workforce projections)
Value & equity integration	Overemphasis on efficiency, challenging integration of equity/justice	Usage of value-based appraisal methods; Deliberative processes for negotiating values
Generalizability & timeliness	Research (e.g., RCTs) not always relevant/generalizable to diverse populations/complex cases; Time lag between research and application	- (Implicitly addressed by focus on context-sensitive research)
Behavioral & political factors	Confirmation bias among practitioners/policymakers; Entrenched stakeholder interests; "Strong vs. strong" confrontations	Educational interventions for critical appraisal; Stakeholder and public engagement; Parliamentary mediation/social consultative bodies

ently limited and ultimately ineffective. Therefore, it is crucial to:

- Implement policies to significantly increase and stabilize research funding, ensuring sufficient duration for complex health policy studies [9]. This will foster the generation of more comprehensive and rigorous evidence.
- Invest in initiatives to improve the quality, methodological rigor, and reliability of domestic health research. A particular focus should be placed on generating timely and context-specific evidence directly relevant to Korean healthcare challenges, addressing the current dearth of such studies [9].
- Establish and adequately resource dedicated organizations or programs specifically tasked with the systematic dissemination of research findings. These entities should actively work to enhance the accessibility of evidence for policymakers and other decision-makers, bridging the existing dissemination gaps [21].

Fostering deliberative processes and stakeholder engagement

Deliberative processes are not merely about gathering more evidence; they are fundamentally about creating a legitimate and transparent arena for negotiating conflicting values and interests that are inherent in complex health policy decisions. This is crucial for overcoming the "strong vs. strong" confrontations observed in Korea and for counteracting the pervasive tendency towards "decision-based evidence making." To achieve this, it is recommended to:

- Actively promote and institutionalize deliberative processes that explicitly integrate scientific evidence with diverse values, practical considerations, and the often-conflicting interests of various stakeholders [24].
- Encourage and facilitate parliamentary mediation or the formation of independent, multi-stakeholder social consultative bodies to resolve contentious policy conflicts and build trust among disparate parties, as highlighted by the medical school enrollment quota controversy.
- Ensure genuine public and stakeholder engagement throughout the entire policy-making cycle. This recognizes their invaluable role in contributing "colloquial evidence" (e.g., lived experiences, community preferences) and thereby enhancing the legitimacy and public acceptance of policies [2].
- Develop clear frameworks and structured methodologies for integrating diverse viewpoints and systematically negotiating ethical and values-based dilemmas, moving beyond a narrow, efficiency-driven focus [9].

Strengthening health technology assessment (hta) integration

Strengthening HTA is vital for institutionalizing evidence-informed decision-making within the Korean healthcare system, as it provides a structured, multi-dimensional framework for comprehensively evaluating interventions and technologies. The empowerment of existing independent HTA bodies, particularly for contentious issues like workforce planning, could significantly depoliticize the evidence generation process and enhance public and professional trust in policy decisions. Specific recommendations include:

- Further integrate Health Technology Assessment (HTA) into all stages of health policy and reimbursement decisions. This integration should ensure that HTA's comprehensive evaluation encompasses not only clinical efficacy but also economic, social, ethical, and legal implications [2].
- Actively address the identified barriers within HTA processes by simplifying complex methodologies, developing clear and practical good practice guidelines, and building internal capacity for robust analyses among HTA practitioners.
- Consider establishing a specialized, independent agency dedicated to long-term health workforce projections and other critical, contentious policy areas. This body should be insulated from short-term political pressures, drawing lessons from successful models in countries like the United States and Japan, to provide more objective and trusted evidence.

Promoting a culture of evidence-informed policy

Ultimately, the effective and sustained implementation of evidence-informed decision-making hinges on a fundamental cultural shift within the policymaking apparatus. This requires moving away from a reactive, politically expedient, or intuition-driven approach towards one that genuinely values, critically appraises, and systematically integrates evidence. This cultural transformation necessitates sustained commitment to capacity building, fostering transparency, and ensuring accountability across the system. Recommendations for this cultural shift include:

- Cultivate strong political will and foster an explicit demand for evidence from policymakers at all levels of government and healthcare administration [2]. This top-down commitment is paramount for driving systemic change.
- Implement comprehensive educational interventions and ongoing training programs for policymakers, healthcare managers, and clinical leaders. These programs should

focus on evidence appraisal, critical thinking skills, understanding the nuances of different evidence types, and recognizing the limitations of evidence [2].

- Develop and disseminate clear, practical frameworks and guidelines for systematically integrating diverse types of evidence—including scientific (context-free and context-sensitive) and colloquial evidence—into the various stages of the decision-making process.

Conclusion

This review has underscored that the Republic of Korea faces both significant challenges and substantial opportunities in effectively integrating evidence into its healthcare decision-making processes. The analysis has highlighted the conceptual complexity of "evidence," encompassing various forms from Evidence-Based Medicine (EBM) to Evidence-Based Public Health (EBPH) and Evidence-Based Health Policy (EBHP), and the multi-level nature of decision-making within the healthcare system.

The case studies of the medical school enrollment quota controversy and the management of non-covered medical services have vividly illustrated the practical tensions between scientific evidence, political imperatives, and stakeholder interests. These examples reveal how evidence can be selectively used to support pre-determined policies, leading to "decision-based evidence making," and how strong economic incentives can divert practice patterns from evidence-based priorities.

Systemic barriers, including insufficient research funding and quality, accessibility issues, the disconnect between research and policy needs, and conflicts over values, have been identified as pervasive challenges. However, the review also points to crucial facilitators, such as policymaker demand for evidence, stakeholder engagement, and the use of deliberative processes.

Strengthening evidence utilization in Korean healthcare demands a comprehensive and integrated approach. This involves not only enhancing the research infrastructure and ensuring the accessibility of high-quality, context-specific evidence but also fostering institutional mechanisms like robust Health Technology Assessment. Crucially, it requires cultivating a culture of genuine evidence-informed policy-making through education, transparent deliberative processes, and a commitment to integrating diverse forms of evidence, including the often-overlooked colloquial evidence and critical societal values. By addressing these multifaceted aspects, Korea can move towards a more sustainable, equitable, and effective healthcare system that truly serves the

health needs of its population.

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Artificial intelligence assisted semi-automation tools using for systematic reviews and guideline development

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This review explores the current landscape of artificial intelligence (AI)-assisted semi-automation tools used in systematic reviews and guideline development. With the exponential growth of medical literature, these tools have emerged to improve efficiency and reduce the workload involved in evidence synthesis. Platforms such as Covidence, EPPI-Reviewer, DistillerSR, and Laser AI exemplify how machine learning and, more recently, large language models (LLMs) are being integrated into key stages of the systematic review process—ranging from literature screening to data extraction. Evidence suggests that these tools can save considerable time, with some achieving average reductions of over 180 hours per review. However, challenges remain in transparency, reproducibility, and validation of AI performance. In response, international initiatives such as the Responsible AI in Evidence Synthesis (RAISE) project and the Guideline International Network (GIN) have proposed frameworks to ensure the ethical, trustworthy, and effective use of AI in health research. These include principles like transparency, accountability, preplanning, and continuous evaluation. This review highlights both the opportunities and limitations of adopting AI in evidence synthesis and underscores the importance of human oversight and rigorous validation to ensure that such tools enhance, rather than compromise, the integrity of systematic reviews and guideline development.

Keywords: Systematic review; Clinical practice guideline; Artificial intelligence; Machine learning; Large language model

Introduction

Systematic review is a major methodology for evidence-decision making in healthcare policy, health technology assessment (HTA) and evidence-based guideline development. Systematic reviews are labor-intensive and time-consuming, typically taking around 41 weeks (nearly a year) from protocol development to final journal submission [1]. The past several years have seen the development and increasing adoption of various machine learning (ML)-based semi-automation tools designed to overcome the challenges inherent in systematic reviews [2]. Despite their individual strengths and weaknesses, these tools have gradually gained traction within the research community. More recently, the wide-

spread emergence of Large Language Models (LLMs) has prompted researchers to explore their potential for systematic review automation. While concerns regarding accuracy and the "black box" nature of LLMs currently necessitate human oversight, ongoing technological advancements hold significant promise for future applications [3,4]. Compared to LLMs, semi-automation tools using conventional ML have gained more trust for preserving methodological rigor. These tools assist in managing workload and improving process efficiency while upholding the strict standards of systematic review [5]. Notably, recent trends indicate an integration of artificial intelligence (AI) functionalities especially LLMs into these tools to further enhance efficiency and broaden their utility. This review aims to explore these recent develop-

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ments and their applicability within the context of systematic reviews.

Current Semi-Automation Tools for Systematic Reviews

While full automation of systematic reviews remains ideal goal, this review focuses on semi-automation. Semi-automation software and platforms were available from several years ago and rapidly expanding their utilities adapting AI-tech, to streamline and expedite various stages of the systematic review process [6]. Study selection has been a primary focus, with numerous tools providing semi-automated and fully automated solutions. Popular platforms like DistillerSR, Covidence, EPPI Reviewer, Abstrackr, and Rayyan have integrated AI-assisted screening. However, many of these tools lack publicly available source code, provide limited information on classifier training, and haven't published performance evaluations. Most screening tools use supervised machine learning, which requires users to manually screen a portion of articles to generate training and test data [7].

AI tools are widely used for various evidence synthesis tasks, ranging from standalone solutions to integrated systematic review platforms. While many tools offer automated solutions for tasks like study selection, they often lack transparency and public performance evaluations. There is a growing interest in using generative LLMs for these tasks due to their potential to reduce the need for extensive training data.

Here are several detailed popular semi-automation tools;

Covidence

Covidence is positioned as a tool to streamline and structure the traditional systematic review process, with a strong focus on the Cochrane methodology. Its user experience is characterized by a prescribed, step-by-step workflow that guides users through screening, conflict resolution, and data extraction, thereby enforcing methodological rigor [8]. The tool is designed for reviewers at all levels of experience. Since 2023, AI-driven literature screening has become feasible through tools like the RCT classifier, and more recently, large language models (LLMs) have begun to be integrated into data extraction tools—marking the initial use of LLMs in this critical phase of evidence synthesis.

EPPI-Reviewer

Developed by the EPPI-Centre at UCL, EPPI-Reviewer is a non-profit, web-based academic tool designed for maximum flexibility. It supports a vast range of review types beyond

standard meta-analyses, including qualitative, mixed-methods, framework, and thematic syntheses. It is intended for reviewers who require the freedom to customize their methods and coding tools. Screening Prioritization (Active Learning) is a core feature. The tool uses text mining and active learning, where the algorithm iteratively learns from the reviewer's decisions to re-rank the remaining abstracts, aiming to find all included studies by screening a smaller portion of the total set. Uniquely supports line-by-line coding of textual data directly from PDFs, creation of conceptual relationship diagrams for qualitative synthesis, and integrated meta-analysis via 'R' libraries (Metafor) for advanced statistical analyses like meta-regression. The latest version integrates OpenAI's GPT-4o for automated coding, where the model can apply codes to titles and abstracts based on user-defined prompts [9].

Laser AI

Developed by Evidence Prime, a spin-off of McMaster University, Laser AI is built from the ground up to support living systematic reviews in high-stakes environments like pharmaceutical companies and health technology assessment (HTA) agencies. Its philosophy centers on efficiency, security, data reusability, and regulatory compliance (e.g., for FDA submissions). This system features a Living Review Architecture that can continuously update, handling up to 15,000 new references monthly, and offers AI-Assisted data extraction to significantly reduce manual effort by suggesting data from PDFs. It also provides robust data management and reusability through controlled vocabularies and clean-up modules, enabling data reuse across projects and export in various structured formats. Furthermore, its Auditability and Compliance features maintain a detailed project history crucial for transparency [10]. The platform leverages AI and Automation Capabilities, including a proprietary natural language processing (NLP) Model for screening prioritization and AI-Assisted Summarization that auto-reports study limitations with traceable source quotations. Additionally, its Advanced Search and RAG (Retrieval-Augmented Generation) capabilities allow natural language queries across extensive databases, showcasing a sophisticated approach to information retrieval [10,11].

DistillerSR

DistillerSR is a web-based, semi-automated tool designed to support the systematic review process, particularly in the title/abstract screening and data extraction phases. It leverages machine learning capabilities, including prioritization

features, to enhance the efficiency of literature reviews [6,12]. DistillerSR demonstrates potential for improving workflows if AI features are further simplified for literature screening and integrated into data extraction processes. However, significant time is required to create a training set to utilize AI functionality effectively, and its customized UI involves complex procedures that necessitate considerable familiarity with the system. As a result, the system received low scores in terms of ease of use and overall usability. Therefore, at this point, its feasibility for adoption requires further reconsideration [13].

Evaluation of Applicability and Performance

In 2020, National Evidence-based Healthcare Collaborating Agency has reviewed five semi-automated tools for systematic review [14] (Table 1). Among the online semi-automated screening programs available in the market, Covidence and EPPI-Reviewer were selected along with three free screening programs—Rayyan, Abstrackr, and Robot Analyst—which were the most frequently used in previous research. Despite its limited functions, the screening performance of Robot reviewer was also analyzed considering its accessibility, practicality, and artificial intelligence (AI)-enabled services. This study, analyzed 77 HTA reports, revealed the typical workload for Systematic Reviews (SRs). The median SR took 10.6 weeks, though "fast-track" assessments were much quicker at about 4 weeks. A major time sink was literature selection, consuming over 40% of the total SR time in more than half the cases. The research suggests semi-automated tools could significantly cut down on literature selection time, especially for "fast-track" and "health technology reassessment" categories, boosting efficiency.

ries, boosting efficiency.

Previous studies compared performance of semi-automated tools show significant potential for workload reduction. A scoping review reported an average time saving of 185 hours when compared to tools like Abstrackr and RobotAnalyst [6]. One comparative study found EPPI-Reviewer could reduce screening burden by 9% to 60%, outperforming Abstrackr in some scenarios. However, performance is highly variable and depends on the review's topic; for a heterogeneous review, its performance was markedly poorer. This highlights a key challenge for credibility and preplanning. Simulation studies suggest active learning can reduce screening effort by 40-50% or more while maintaining high recall. In some contexts, such as for in vitro studies where abstracts may be poor indicators of relevance, text mining on titles and abstracts has been shown to outperform human screening [15]. Recent work has addressed the limited adoption of machine learning in automating data extraction for environmental health literature. Dextr, a web-based semi-automated tool, was developed to support hierarchical data extraction through user-verified predictions and token-level annotations. In testing with 51 animal studies, Dextr maintained similar precision (96.0%) and slightly reduced recall (91.8%) compared to manual extraction, while halving extraction time [11]. A systematic review evaluated the performance and workload reduction of AI-based tools for literature screening in cancer-related systematic reviews. Five studies assessed four tools—Abstrackr, RobotAnalyst, EPPI-Reviewer, and DistillerSR—demonstrating varying efficiencies. Abstrackr showed the highest time savings, eliminating up to 88% of abstracts and 59% of full-texts without missing included citations. Other tools showed

Table 1. Semi-Automation Tools Comparative Functions (Evaluated in 2020)

Steps Programs	Literature search results import	Literature screening		Risk of bias assessment	Data extraction and synthesis	AI integration (as of 2025)
		Title/abstract screening	Fulltext screening			
Covidence	Import data, Manage duplicates ^{b)}	Priority screening, Highlights ^{a)}	Bulk upload of full text ^{a)}	Risk of bias 1.0, customized ^{a)}	Data Extraction form ^{b)}	RCT Classifier, LLM Data extraction
EPPI-Reviewer	Search (PubMed), Import data, Manage duplicates ^{a)}	Priority screening, Allocation, Highlight ^{a)}	Upload of full text ^{a)}	Various, customized ^{a)}	Data Extraction form, Meta-analysis ^{a)}	AI screening, LLM (GPT 4o)
Rayyan	Import data, Search (PubMed) ^{b)}	ML-assisted prioritization, Highlight ^{a)}	Upload of full text			AI screening
Abstrackr	Import data ^{b)}	Active learning, Highlight ^{a)}				ML-AI screening
RobotAnalyst	Import data ^{b)}	Text-mining function, RobotAnalyst ^{a)}				LLM introducing

^{a)}All needed functions are provided.

^{b)}Not all needed functions are provided.

LLM: large language model, ML: machine-learning.

more modest reductions [16].

Overall, these findings underscore the growing utility of semi-automated tools in improving the efficiency of systematic reviews, while also highlighting the need for careful consideration of tool selection based on review characteristics and domains.

International Guidance for Use in Systematic Reviews

The Responsible AI in Evidence Synthesis (RAISE) project is an initiative designed to address the challenges associated with the use of Artificial Intelligence (AI) tools in evidence synthesis [17]. The project aims to provide guidance to the evidence synthesis community on how and when to effectively and responsibly utilize AI, given the rapid influx of AI tools promising to streamline the process. It highlights that the mere availability of AI does not justify its use, and improper application can hinder the evidence synthesis process, potentially introducing or exacerbating harms. The RAISE project's guidance is structured into three main documents:

- RAISE 1: This document offers tailored recommendations for various roles within the evidence synthesis ecosystem, including evidence synthesists, methodologists, AI tool development teams, organizations producing evidence synthesis, publishers, funders, users, and trainers of evidence synthesis methods.
- RAISE 2: This part provides guidance on the development and evaluation of AI evidence synthesis tools. It focuses on how to determine if an AI tool performs as claimed to an acceptable standard, including methods for building and validating these tools, conducting evaluations, considering performance metrics, and reporting findings.
- RAISE 3: This specific document (the source of this information) focuses on guiding users in selecting and utilizing AI evidence synthesis tools. It offers an overview of the current state of AI in evidence synthesis and provides advice on assessing tools for both external and internal validity, along with key ethical, legal, and regulatory considerations.

Guideline International Network (GIN) also published the consensus for the responsible and transparent use of Artificial Intelligence (AI) in health guideline development. Recognizing the rapid evolution and potential of AI, as well as the lack of specific guidance in this domain, GIN aims to support guideline developers in leveraging AI tools effectively while ensuring trustworthiness and adherence to ethical standards [18].

Framework outlines eight key principles for integrating AI into health guideline development, prioritizing ethical and effective implementation. First, transparency is crucial; all AI tools, data, and methods must be clearly documented and understandable, detailing human involvement and any deviations. Preplanning requires anticipating AI's advantages, risks, and limitations, considering methodological choices, budget, and equity. AI use should offer clear additionality, providing gains beyond non-AI tools through new capabilities or increased efficiency. Credibility demands that AI tools demonstrate sufficient quality for their intended application, with performance assessments guiding selection. Furthermore, ethics are paramount, requiring adherence to human rights, equity, and data privacy, addressing potential biases. Accountability necessitates human oversight to direct AI use and ensure compliance with legal frameworks, with clear mechanisms for examining AI-generated content quality. Compliance ensures all AI tools and processes meet relevant legal and regulatory standards. Finally, continuous evaluation of AI's use and effects is vital given its rapid evolution. These principles offer a flexible yet foundational framework, emphasizing transparency and ongoing assessment to foster trustworthy guidelines.

These two statements highlight a shared, critical need for responsible and transparent AI integration within evidence synthesis and health guideline development. Both the RAISE project and the Guideline International Network (GIN) recognize AI's transformative potential while emphasizing that its mere availability doesn't justify its use. Ultimately, both initiatives converge on the idea that effective AI implementation in these fields hinges on clear documentation, rigorous ethical considerations, human oversight, and ongoing assessment to ensure trustworthiness and prevent harm.

Conclusion

AI-assisted semi-automation is not a futuristic concept but a present-day reality that is already transforming how we conduct systematic reviews and develop guidelines. These tools are not autonomous "robot reviewers" but sophisticated assistants that empower researchers to synthesize evidence with greater speed and scale than ever before. The future lies in a seamless human-AI collaborative ecosystem. To fully realize its potential, researchers must prioritize transparency, ethical use, and ongoing evaluation, ensuring that these tools serve as reliable partners in producing timely, high-quality systematic reviews and clinical guidelines.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Data Availability Statement

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Ethics Approval and Consent to Participate

Not applicable.

Authors Contributions

All the work was done by Miyoung Choi.

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J Evid-Based Pract aims to present 1) Original evidence-based research on important issues in healthcare, 2) Methods, tools, and concepts essential for evidence-based medicine (EBM), education and practice, 3) Perspectives, debates, analyses, and opinions on reliable evidence and related topics in evidence-based medicine.

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For the policies on research and publication ethics, the "Good Publication Practice Guidelines for Medical Journals" (https://www.kamje.or.kr/board/view?b_name=bo_publication&bo_id=13) or the "Ethical Guidelines on Good Publication" (<http://publicationethics.org/resources/guidelines>) or "Ethical Considerations in the International Committee of Medical Journal Editors" (<http://www.icmje.org/recommendations>) are applied.

1. Conflict-of-interest statement

The corresponding author is required to summarize all authors' conflict of interest disclosures. The disclosure form shall be same with ICMJE Uniform Disclosure Form for Potential Conflicts of Interest (www.icmje.org/conflicts-of-interest). A conflict of interest may exist when an author (or the author's institution or employer) has financial or personal relationships or affiliations that could influence (or bias) the author's decisions, work, or manuscript. All authors should disclose their conflicts of interest, i.e., (1) financial relationships (such as employment, consultancies, stock ownership, honoraria, paid expert testimony), (2) personal relationships, (3) academic competition, and (4) intellectual passion. These conflicts of interest must be included as a footnote on the title page or in the Acknowledgements section.

All funding sources should be declared on the title page or in the Acknowledgements section at the end of the text. If an author's disclosure of potential conflicts of interest is determined to be inaccurate or incomplete after publication, a correction will be published to rectify the originally published disclosure statement, and additional action may be taken as necessary.

If one or more editors are involved as authors, the authors should declare conflict of interest.

Ex) AAA has been an editor of the Journal of Evidence-Based Practice since 2017; however, he was not involved in the

peer reviewer selection, evaluation, or decision process of this article. No other potential conflicts of interest relevant to this article were reported.

2. Statement of informed consent

Copies of written informed consents and Institutional Review Board (IRB) approval for clinical research are recommended to be kept. The editor or reviewers may request copies of these documents to clarify potential ethical issues.

3. Protection of privacy, confidentiality, and written informed consent

Identifying details should not be published in written descriptions, photographs, or pedigrees unless it is essential for scientific purposes and the patient (or his/her parents or guardian) provides written informed consent for publication. Additionally, informed consent should be obtained in the event that the anonymity of the patient is not assured. For example, masking the eye region of patients in photographs is not adequate to ensure anonymity. If identifying characteristics are changed to protect anonymity, authors should assure that alterations do not distort scientific meaning. When informed consent has been obtained, this should be indicated in the published article.

4. Protection of human and animal rights

In the reporting of experiments that involve human subjects, it should be stated that the study was performed according to the Helsinki Declaration of 1975 (revised 2013) (Available from <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>) and approved by the Institutional Review Board (IRB) of the institution where the experiment was performed. Clinical studies that do not meet the Helsinki Declaration will not be considered for publication. Identifying details should not be published (such as name, initial of name, ID numbers, or date of birth).

In the case of an animal study, a statement should be provided indicating that the experimental processes, such as the breeding and the use of laboratory animals, were approved by the Research Ethics Committee (REC) of the institution where the experiment was performed or that they did not violate the rules of the REC of the institution or the NIH Guide for the Care and Use of Laboratory Animals (Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council, <https://www.nap.edu/catalog/5140/guide-for-the-care-and-use-of-laboratory-animals>). The authors should preserve raw experimental study data for

at least 1 year after the publication of the paper and should present this data if required by the Editorial Board.

5. Registration of the clinical research

All prospective studies must be registered in the primary registry before submission. *J Evid-Based Pract* accepts registration in any of the primary registries that participate in the World Health Organization (WHO) International Clinical Trials Portal (<http://www.who.int/ictrp/en>), NIH ClinicalTrials.gov (<http://www.clinicaltrials.gov>), or Korea Clinical Research Information Service (CRIS, <http://cris.nih.go.kr>).

6. Reporting guidelines

The *J Evid-Based Pract* recommends that a submitted manuscript follow reporting guidelines appropriate for various study types. Good sources for reporting guidelines are the EQUATOR Network (www.equatornetwork.org) and the NLM's Research Reporting Guidelines and Initiatives (www.nlm.nih.gov/services/research_report_guide.html).

7. Author and authorship

An author is considered to be an individual who has made substantive intellectual contributions to a published study and whose authorship continues to have important academic, social, and financial implications.

Authorship credit should be based on: (1) substantial contributions to the conception or design of the work, or to the acquisition, analysis, or interpretation of data for the work; (2) the drafting of the article or revising it critically for important intellectual content; (3) final approval of the version to be published; and (4) agreement on taking accountability for the accuracy or integrity of the work. Authors should meet these four criteria, and these criteria distinguish the authors from other contributors.

Correction of authorship after publication: *J Evid-Based Pract* does not correct authorship after publication unless a mistake has been made by the editorial staff. Authorship may be changed before publication but after submission when an authorship correction is requested by all of the authors involved with the manuscript.

When a large, multicenter group has conducted the work, the group should identify the individuals who accept direct responsibility for the manuscript. When submitting a manuscript authored by a group, the corresponding author should clearly indicate the preferred citation and identify all individual authors as well as the group name. Acquisition of funding, collection of data, or general supervision of the research group alone does not constitute authorship. Journals gener-

ally list other members of the group in the Acknowledgments section.

8. Plagiarism and duplicate publication

Plagiarism is the use of previously published material without attribution. Prior to peer review, all manuscripts are screened for plagiarism by the Editor-in-Chief using iThenticate. When plagiarism is detected at any time before publication, the *J Evid-Based Pract* editorial office will take appropriate action as directed by the standards set forth by the Committee on Publication Ethics (COPE). For additional information, please visit <http://www.publicationethics.org>. Text copied from previously published work is interpreted using the following taxonomy:

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Deliberate copying of large blocks of text without attribution

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Copying of “generic” text, e.g., a description of a standard technique, without clear attribution

3) Plagiarism for scientific English

Copying of verbatim text, often from multiple sources

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Use of verbatim text without identifying it as a direct quotation but citing the source

5) Self-“plagiarism”

Manuscripts are only accepted for publication if they have not been published elsewhere. Manuscripts published in this journal should not be submitted for publication elsewhere. Duplicate submissions identified during peer review will be immediately rejected, and duplicate submissions that are discovered after publication will be retracted. It is mandatory for all authors to resolve any copyright issues when citing a figure or table from a different journal that is not open access.

When a duplicate publication is detected, the *J Evid-Based Pract* editorial office will notify the counterpart journal of this violation. Additionally, it will be notified of the authors’ affiliation, and penalties will be imposed on the authors. It is possible to republish manuscripts if they satisfy the condition of secondary publication of the Uniform Requirements for Manuscripts Submitted to Biomedical Journals, available at: www.icmje.org. If the author or authors wish to obtain a duplicate or secondary publication for reasons such as publication for readers of a different language, the author(s) should obtain approval from the Editors-in-Chief of both the first and second journal.

V. Manuscript Preparation

J Evid-Based Pract recommends compliance with some or all of the following guidelines (<https://www.equator-network.org>).

CONSORT for reporting of randomized controlled trials (<http://www.consort-statement.org>)

STARD for reporting of diagnostic accuracy studies (<http://www.stard-statement.org>)

STROBE for reporting of observational studies in epidemiology (<http://www.strobe-statement.org>)

PRISMA for reporting of systematic reviews (<http://www.prisma-statement.org>)

MOOSE for reporting of Meta-analyses of observational studies (<https://jamanetwork.com/journals/jamasurgery/article-abstract/2778476>)

CARE for reporting of clinical cases (<https://www.care-statement.org>)

AGREE for reporting clinical practice guidelines (<http://www.agreetrust.org/resource-centre/agree-reporting-checklist/>)

ARRIVE for reporting of animal pre-clinical studies (<https://arriveguidelines.org/arrive-guidelines>)

1. Word processors and format of manuscripts

A manuscript must be written in proper and clear English. Our preferred file format is DOCX or DOC. Manuscripts should be typed double-spaced on A4-sized paper, using 12 point font in English.

2. Abbreviation of terminology

Abbreviations should be avoided as much as possible. When they are used, full expression of the abbreviated words should be provided at the first use, with the abbreviation following in parentheses. Common abbreviations may be used, however, such as DNA. Abbreviations can be used if they are listed as a MeSH subject heading (<https://www.ncbi.nlm.nih.gov/mesh>).

3. Word spacing

1) Leave 1 space on each side when using arithmetic marks such as +, -, ×, etc.

Ex) 24 ± 2.5

Leave no space when using a hyphen between words.

Ex) intra-operative

2) When using parentheses, leave 1 space on each side.

3) When using brackets in parentheses, apply square brackets.

Ex) ([])

4. Citations

- 1) If a citation has 2 authors, write as “Hirota and Lambert”.
If there are more than 3 authors, apply “et al.” at the end of the first author’s surname.

Ex) Kim et al. [1]

- 2) Citations should be applied after the last word.

Ex) It is said that hypertension can be induced [1] and the way to injure the brain [2] is...

Ex) Choi and Kim [1] reported...

- 3) Apply citations before a comma or period.

Ex)is reported [1],

- 4) Several or coupled superscripts can be written as [1–5] or [1,3,5].

5. Arrangement of manuscript

The manuscript should be organized in the order of title, abstract, introduction, methods, results, discussion, acknowledgments, references, tables, figures, and figure legends. Figures should be uploaded as separate files. The title of each new section should begin on a new page. The conclusion should be included in the discussion section. Number pages consecutively, beginning with the first page of the manuscript. Page numbers should be placed in the middle of the bottom of the page. For survey-based clinical studies, the original survey document does not need to be included in the body of the manuscript but may be included as a supplement in an appendix.

6. Organization of manuscript

1) Original Article

- (1) Cover page (upload separately)

① Title

Title should be concise and precise. The first word should be capitalized. Drug names in the title should be written with generic names, not brand names. For the title, only the first letter of the first word should be capitalized.

Ex) Effect of smoking on bronchial mucus transport velocity under total intravenous anesthesia [○]

Ex) Effect of Smoking on Bronchial Mucus Transport Velocity under Total Intravenous Anesthesia ... [×]

Provide drug names as generic names, not product names.

Ex) In CPR, Isosorbide Dinitrate is, [○]

Ex) In CPR, Isosorbide Dinitrate (Isoket®) is, [×]

Ex) In CPR, Isoket® is, [×]

② Running title

A running title should be provided with no more than 40 characters, including letters and spaces in Korean, or 10 words in English. If this title is inappropriate, the Editorial Board may revise it.

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First name, middle initial, and last name of each author, with their highest academic degree(s) (M.D., Ph.D., etc.), and institutional affiliations; make sure the names of and the order of authors as they appear on the Title Page and entered in the system match exactly.

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Title of the conference, date of presentation, and the location of the conference may be described.

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It should be the same as the Cover page.

② Abstract

All manuscripts should contain a structured abstract that is written only in English. Authors should provide an abstract of no more than 250 words. It should contain 4 subsections: Background, Methods, Results, and Conclusions. Citation of references is not permitted in the abstract. A list of key words at least 6, with a maximum of 10 items, should be included at the end of the abstract. Key words should be selected from MeSH (<https://www.ncbi.nlm.nih.gov/mesh>), and these should be written in small letters with the first letter capitalized. Separate each word with a semicolon (;), and include a period (.) at the end of the last word.

Ex) Keywords: Carbon dioxide; Cerebral vessels; Oxygen; Spinal analgesia.

③ Introduction

The introduction should address the article’s purpose concisely and include background information relevant to the paper’s purpose.

④ Methods

The methods section should include sufficient details regarding the design, subjects, and methods of the research in order, as well as methods used for data analysis and control of bias in the study. Sufficient details must be provided in the methodology section of an experimental study so that others can further replicate it. The study design whether descriptive analysis, randomized controlled study, cohort study, or meta-analysis should be stated.

Materials and/or Participants: The materials used in the research should be clearly detailed to facilitate follow-up studies. Any materials purchased should be listed with the source or manufacturer. Research participants should also be precisely described with parameters such as age, sex, region, school, country, date of intervention period, occupation, etc. Reasons for inclusion or selection of participants should be explained. If a certain group was excluded, this should be explained as well. Questionnaires in non-English languages may also be included in the Appendix. Statistical analysis should be meticulously described. If reviewers want to analyze the data to confirm the results, the raw data may be provided to the editorial office. Computer programs used for the statistical analysis should be stated with the name, manufacturer, and software version used. Along with the statistical results, we encourage the inclusion of measurement error or uncertainty, such as listing confidence intervals in addition to providing P-values.

Institute and author names should be avoided.

When reporting experiments with human or animal subjects, the authors should indicate ethics statement whether they received approval from the Institutional Review Board for the study. If no IRB number is available, this should be discussed with the editor during the review process. When reporting experiments with animal subjects, the authors should indicate whether the Institutional Board supervised the handling of the animals for the Care and Use of Laboratory Animals. Demographic data should be included in the materials and methods section if applicable. As a rule, subsection titles are not recommended. If several study designs were used, then subtitles can be used without assigning numbers.

Ensure correct use of the terms sex (when reporting biological factors) and gender (identity, psychosocial or cultural factors), and, unless inappropriate, report the sex and/or gender of study participants, the sex of animals or cells, and describe the methods used to determine sex and gender. If the study was done involving an exclusive population, for example in only one sex, authors should justify why, except in obvious cases (e.g., prostate cancer).

Authors should define how they determined race or ethnicity and justify their relevance.

- **Units** Laboratory information should be reported using the International System of Units [SI], avail-

able at: <https://www.nist.gov/pml/special-publication-811>

< Exceptions >

- A. The unit for volume is “L,” while others should be written as “dl, ml, μ l”

Ex) 1 L, 5 ml

- B. The units for pressure are mmHg or cmH₂O. instead of Pascal.

- C. Use Celsius for temperature. oC

- D. Units for concentration are M, mM, μ M.

Ex) μ mol/L; [$\times$]

- E. When more than 2 items are presented, diagonal slashes are acceptable for simple units.

Negative exponents should not be used.

Ex) mg/kg/min [O], mg $\cdot$ kg⁻¹ $\cdot$ min⁻¹ [$\times$]

- F. Leave 1 space between number and units, except %, °C.

Ex) 5 mmHg

Ex) 5%, 36oC

- G. Units of time

Ex) hour: 1 h = 60 min = 3,600 s, day: 1 d = 24 h = 86,400 s

- **Machines and equipment**

According to the 11th edition of the American Medical Association, provide the model name and manufacturer’s name without the country.

For drug names, use generic names. If a brand name should be used, insert it in parentheses after the generic name. Provide® or TM as a superscript and the manufacturer’s name.

- **Ions**

Ex) Na⁺[O], Mg²⁺[O], Mg⁺⁺[$\times$], Mg²⁺[$\times$]

Ex) Premedicated magnesium [O]

Ex) Premedicated Mg²⁺ [O]

⑤ Results

Results should be presented in a logical sequence in the text, tables, and figures, giving the main or most important findings first. Do not repeat all the data provided in the tables or figures in the text; emphasize or summarize only the most important observations. Results can be sectioned by subsection titles but should not be numbered. The citation of tables and figures should be provided as Table 1 and Fig. 1.

Type or print each table on a separate page. Figures should be uploaded as separate tif, jpg, pdf, gif, ppt files.

⑥ Statistics

Precisely describe the methods of statistical analysis

and computer programs used. Mean and standard deviation should be described as mean $\pm$ SD, and mean and standard error should be written as mean $\pm$ SEM. Median and interquartile should be described as median (1Q, 3Q). When displaying P values, use a capital P and do not put a “-” between “P” and “value”.

- A. Describe the statistical tests employed in the study in enough detail so readers can reproduce the same results if the original data are available. The name and version of the statistical package should be provided.
 - B. Authors should describe the objective of the study and hypothesis appropriately. The primary/secondary endpoints are predetermined sensibly according to the objective of the study.
 - C. The characteristics of measured variables should determine the use of a parametric or nonparametric statistical method. When a parametric method is used, the authors should describe whether the basic statistical assumptions are met.
- For an analysis of a continuous variable, the normality of data should be examined. Describe the name and result of the particular method to test normality.
- D. When analyzing a categorical variable, an exact test or asymptotic method with appropriate adjustments should be used if the number of events and sample is small. The standard chi-squared test or difference-in-proportions test may be performed only when the sample size and the number of events are sufficiently large.
 - E. The *J Evid-Based Pract* strongly encourages authors to show confidence intervals, and it is not recommended to present the P value without showing the confidence interval. In addition, the uncertainty of estimated values, such as the confidence interval, should be described consistently in figures and tables.
 - F. Except for study designs that require a one-tailed test, for example, non-inferiority trials, the P values should be two-tailed. A P value should be expressed up to three decimal places (ex. $P = 0.160$ not as $P = 0.16$ or $P < 0.05$). If the value is less than 0.001, it should be described as “ $P < 0.001$ ” but never as “ $P = 0.000$.” For large P value greater than 0.1, the values can be rounded off to one decimal place, for example, $P = 0.1$, $P = 0.9$.
 - G. A priori sample size calculation should be described in detail. Sample size calculation must aim at preventing false negative results pertaining to the primary, instead of secondary, endpoint. Usually, the mean dif-

ference and standard deviation (SD) are typical parameters in estimating the effect size. The power must be equal to or greater than 80 percent. In the case of multiple comparisons, an adjusted level of significance is acceptable.

- H. When reporting a randomized clinical study, a CONSORT type flow diagram, as well as all the items in the CONSORT checklist, should be included. If limited in terms of the space of the manuscript, this information should be submitted as a separate file along with the manuscript.
- I. Results must be written in significant figures. The measured and derived numbers should be rounded off to reflect the original degree of precision. Calculated or estimated numbers (such as mean and SD) should be expressed in no more than one significant digit beyond the measured accuracy. Therefore, the mean (SD) of cardiac indices in patients measured on a scale that is accurate to 0.1 L/min/m² should be expressed as 2.42 (0.31) L/min/m².
- J. Except when otherwise stated herein, authors should conform to the most recent edition of the American Medical Association Manual of Style.

⑦ Discussion

The discussion should be described to emphasize the new and important aspects of the study, including the conclusions. Do not repeat in detail the results or other information that is provided in the introduction or the results section. Describe the conclusions according to the purpose of the study but avoid unqualified statements that are not adequately supported by the data. Conclusions may be stated briefly in the last paragraph of the discussion section.

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All authors are required to provide a fully completed ORCID profile. ORCID registration is free and available to researchers worldwide through the ORCID website (<https://orcid.org>). Manuscripts submitted by authors who have not fully completed their ORCID profiles will not be considered for authorship and will be removed from the author list. Furthermore, if any listed author fails to meet this requirement, the manuscript will not proceed to the peer review process. An example ORCID profile is as follows: Owen Lee: <https://orcid.org/0000-0002-2117-1437>.

⑨ Authors' contributions

J Evid-Based Pract participates in the CRediT standard for author contributions. As such, the contribu-

tions of all authors must be described using the CRediT Taxonomy of author roles. For each of the categories below, please enter the initials of the authors who contributed in that category. If listing more than one author in a category, separate each set of initials with a space. If no author contributed to a category, you may leave that box blank.

The corresponding author is responsible for completing this information at submission, and it is expected that all authors will have reviewed, discussed, and agreed to their individual contributions before this time.

Examples of authors' contributions:

- Conceptualization: OL.
- Data curation: OL.
- Formal analysis: GJC.
- Funding acquisition: OL.
- Methodology: OL HK GJC.
- Project administration: GJC.
- Visualization: OL HK GJC.
- Writing – original draft: OL GJC.
- Writing – review & editing: OL HK GJC.

⑩ Conflict of Interest

Any conflicts should be disclosed here. This statement must be included regardless of the existence of conflicts of interest. If the authors have nothing to disclose, please state: "No potential conflict of interest relevant to this article was reported."

⑪ Funding

Financial support, including foundations, institutions, pharmaceutical and device manufacturers, private companies, intramural departmental sources, or any other support, should be described.

⑫ Data Availability Statement

J Evid-Based Pract has implemented a mandatory data sharing policy, requiring authors to submit raw data or data files at the time of manuscript submission for editorial review. Manuscripts submitted without the required dataset will not proceed to peer review. These data are essential for verifying the accuracy of the analysis and ensuring the reproducibility of results. Authors must upload data files in csv, xls, xlsx, or txt format. If an alternative file format is necessary, prior approval from the editorial office is required. If data sharing is restricted due to agreements with the data provider or other justified reasons, authors must consult with the editorial office before submission to discuss alternative data-sharing arrangements.

⑬ Acknowledgments

Persons or institutes that contributed to the manuscript but not sufficiently to be co-authors may be recognized.

⑭ Supplementary Materials

If supplementary materials are available, either to aid in reader understanding or because data are too abundant for inclusion in the main text, these may be included as supplementary data. Data files, as well as abstract recording, text, audio, or video files, can be added here.

⑮ References

- References should be obviously related to documents and should not exceed 50 in number. The number of references should not exceed 100 in reviews. However, the number of references has no limitation in systematic review and meta-analysis. References should be numbered consecutively in the order in which they are first mentioned in the text. Provide citations in the body text. All references should be listed in English, including author, title, name of journal, etc.
- The format for references follows the descriptions below. Otherwise, it follows the NLM Style Guide for Authors, Editors, and Publishers (Patrias, K. Citing medicine: the NLM style guide for authors, editors, and publishers [Internet]. 2nd ed. Wendling, DL, technical editor. Bethesda (MD): National Library of Medicine (US); 2007 [updated 2015 Oct 2; cited Year Month Day]. Available at: www.ncbi.nlm.nih.gov/books/NBK7256/).
- If necessary, the Editorial Board may request original documents for the references.
- The journal title should be listed according to the List of Journals Indexed for MEDLINE, available at: <https://www.nlm.nih.gov/archive/20130415/tsd/serials/lji.html>, or the List of KoreaMed Journals (journal browser of KoreaMed Services), available at: <http://koreamed.org/JournalBrowserNew.php>.
- Six authors can be listed. If there are more than 6 authors, only list 6 names with "et al."
- Provide the start and final page numbers of the cited reference.
- Abstracts of conferences may not be included in the references. The American Society of Anesthesiologists (ASA) refresher course lecture is not acceptable as a reference.
- Description format

A. Regular journal

- Author name. Title of article. Name of journal published year; volume: start page-final page.

Ex) Rosenfeld BA, Faraday N, Campbell D, Dorman T, Clarkson K, Siedler A, et al. Perioperative platelet activity of the effects of clonidine. *Anesthesiology* 1992; 79: 256-61.

Ex) Hirota K, Lambert DG. Ketamine: its mechanism(s) of action and unusual clinical uses. *Br J Anaesth* 1996; 77: 741-4.

Ex) Kang JG, Lee SM, Lim SW, Chung IS, Hahm TS, Kim JK, et al. Correlation of AEP, BIS, and OAA/S scores under stepwise sedation using propofol TCI in orthopedic patients undergoing total knee replacement arthroplasty under spinal anesthesia. *Korean J Anesthesiol* 2004; 46: 284-92.

- Journal article volume with supplement

Ex) Doherty JS, Froom SR, Gildersleve CD. Pediatric laryngoscopes and intubation aids old and new. *Pediatr Anaesth* 2009; 19 Suppl 1: 30-7.

- Journal article issue with supplement

Ex) Lee S, Han JW, Kim ES. Butyrylcholinesterase deficiency identified by preoperative patient interview. *Korean J Anesthesiol* 2013; 65(6 Suppl): S1-3.

B. Monographs

- Author. Book name. Edition. Place, press. Published year, pp (start page)-(End page).

- If reference page is only 1 page, mark 'p'.

- Note if it is beyond the 2nd edition.

Ex) Nuwer MR. Evoked potential monitoring in the operating room. 2nd ed. New York, Raven Press. 1986, pp 136- 71.

- Translated documents cannot be used as references. The original documents should be provided as references.

C. Chapter

Any separate author of a chapter should be provided.

Ex) Blitt C. Monitoring the anesthetized patient. In: *Clinical Anesthesia*. 3rd ed. Edited by Barash PG, Cullen BE, Stoelting RK: Philadelphia, Lippincott-Raven Publishers. 1997, pp 563-85.

D. Electronic documents

Ex) Grainge MJ, Seth R, Guo L, Neal KR, Coupland C, Vryenhoef P, et al. Cervical human papillomavirus screening among older women. *Emerg Infect Dis* [serial on the Internet]. 2005 Nov [2005 Nov 25]. Available from wwwnc.cdc.gov/eid/article/11/11/05-0575_article.

E. Online journal article

Ex) Sampson AL, Singer RF, Walters GD. Uric acid lowering therapies for preventing or delaying the progression of chronic kidney disease. *Cochrane Database Syst Rev* 2017; 10: CD009460.

F. Advance access article

Ex) Baumbach P, Gotz T, Gunther A, Weiss T, Meissner W. Chronic intensive care-related pain: Exploratory analysis on predictors and influence on health-related quality of life. *Eur J Pain* 2017. Advance Access published on Nov 5, 2017. doi:10.1002/ejp.1129.

The reference style for *J Evid-Based Pract* is conveniently available as an out-of-the-box style within both EndNote and RefWorks.

⑩ Tables

Only one table is to be drawn per page in the order cited in the text.

The title of the table is to be in English and written at the top of the table in the form of a phrase.

Words in the table excluding the title should use capital letters for the first word, and the following words are to be written in small letters.

For demographic data, gender is recorded as M/F, age as yr, (if necessary, use days or months in children) without decimal point. The “±” sign within the table is to be aligned with the rows above and below.

Footnotes are to be written in the following order: “Values are mean ± SD (or SEM) or median (1Q, 3Q)”, the explanations for the groups and the abbreviations in order of appearance, and statistics. Abbreviations apart from internationally recognized abbreviations are to be explained with their full spellings at the bottom of the table. Full spellings are to be presented even for repeated abbreviations for each table in order of appearance.

Significance marks are to conform to the Vancouver style (Uniform Requirements for Manuscripts Submitted to Biomedical Journals. *JAMA* 1997; 227: 927-34). In other words, these must be in the order of *, †, ‡, §, ||, ¶, **, ††, ‡‡ and written as superscripts.

⑪ Legends for figures and photographs

All of the figures and photographs should be described in the text separately.

The description order is the same as in the footnotes in tables and should be in recognizable sentences.

Define all abbreviations every time they are repeated.

(3) Figures and Photographs

- ① JBEP encourages authors to use color to increase the clarity of figures. Please note that color figures are used without charge for online reading. However, since it will be charged upon the publication, authors may choose to use colors only for online reading.
- ② Standard colors should be used (black, red, green, blue, cyan, magenta, orange, and gray). Avoid colors that are difficult to see on the printed page (e.g., yellow) or are visually distracting (e.g., pink). Figure backgrounds and plot areas should be white, not gray. Axis lines and ticks should be black and thick enough to frame the image clearly. Axis labels should be large enough to be easily readable, and printed in black.
- ③ Figures should be uploaded as separate tif, jpg, pdf, gif, or ppt files. The width of figure should be 84 mm (one column). The contrast of photos or graphs should be at least 600 dpi. The contrast of line drawings should be at least 1,200 dpi. Number figures as "Fig. (Arabic numeral)" in the order of their citation (ex. Fig. 1).
- ④ Photographs should be submitted individually. If Fig. 1 is divided into A, B, C, and D, do not combine it into 1, but submit each of them separately. Authors should submit line drawings in black and white.
- ⑤ In horizontal and vertical legends, the letter of the first English word should be capitalized.
- ⑥ Connections between numbers should be denoted by "-", not "~". Do not space the numbers (ex. 2-4).
- ⑦ An individual should not be recognizable in photographs or X-ray films unless written consent has been obtained from the subject and is provided at the time of submission.
- ⑧ Pathological samples should be pictured with a measuring stick.

2) Review

This review article synthesizes previously published material into an integrated presentation of our current understanding of a topic. Review articles should describe aspects of a topic in which scientific consensus exists, as well as aspects that remain controversial and are the subject of ongoing scientific disagreement and research. Review articles are invited only by editorial board. If authors want to submit an unsolicited review article, please contact editorial office (ksebm.office@gmail.com). Review articles should include unstructured abstracts written in English equal to or less than 250 words. The organization should be in order of abstract, introduction, text following each title, conclusion and references.

Figures and tables should be provided in English. Body text should not exceed 30 A4-sized pages, and the number of figures and tables should each be less than 6. However, if necessary, the number of pages, the number of figures and tables can be added in accordance with the decision of the editorial committee.

3) Systematic review and meta-analysis

Systematic review and meta-analysis are considered as an original article. Systematic reviews are systematic, critical assessments of literature and data sources in order to answer a specific question, and/or includes a statistical technique leading to a quantitative summary of results and examining sources of differences in results among studies, if any. The subtitle should include the phrase "A systematic review" and/or "A Meta-analysis." Organization of systematic review and meta-analysis: Same as original article, except,

- All systematic reviews and meta-analyses should be registered at an appropriate online public registry (eg, PROSPERO; <http://www.crd.york.ac.uk/PROSPERO/>), and registration information should be included with the submission. Authors of reports of meta-analyses of clinical trials should submit the PRISMA flow diagram. The PRISMA checklist should be submitted as a separate file along with the manuscript. For information regarding PRISMA guidelines, please visit <http://www.prisma-statement.org> or EQUATOR Network (<https://www.equator-network.org/home/>). Systematic reviews and meta-analyses of observational studies in epidemiology should be reported according to MOOSE guidelines. For more information regarding MOOSE guidelines, please visit <http://www.equator-network.org/reporting-guidelines/meta-analysis-of-observational-studies-in-epidemiology-a-proposal-for-reporting-meta-analysis-of-observational-studies-in-epidemiology-moose-group/>.
- Number of references has no limitation in systematic review and meta-analysis.

4) Case Report

A case report is almost never a suitable means to describe the efficacy of a treatment or a drug; instead, an adequately powered and well-controlled clinical trial should be performed to demonstrate such efficacy. The only context in which a case report can be used to describe efficacy is in a clinical scenario, or population, that is so unusual that a clinical trial is not feasible. Case reports of humans must state in the text that informed consent to publication was obtained from the patient or guardian. Copies of written informed consents should be kept. If necessary, the editor or reviewers

may request copies of these documents. If these steps are impossible, Institutional Review Board approval should be obtained prior to submission. The rarity of a disease condition is itself not an acceptable justification for a case report. Statement describing compliance with CARE for reporting of clinical cases (<https://www.care-statement.org>) guideline is recommended.

- (1) Cover page: Same as that for clinical and experimental studies.
- (2) Abstract: All case reports should contain a structured abstract that is written only in English. Provide an abstract of no more than 150 words. It should contain 3 subsections: Background, Case, and Conclusions. A list of keywords, with a Minimum of 6, should be included at the end of the abstract.
- (3) Introduction: Should not be separately divided. Briefly describe the case and background without a title.
- (4) Case report: Describe only the clinical information that is directly related to the diagnosis and anesthetic management.
- (5) Discussion: Briefly discuss the case, and state conclusions at the end of the case. Do not structure the conclusion section separately.
- (6) References: The number of references should be less than 20. However, if necessary, the number of reference

can be added in accordance with the decision of the editorial committee.

- (7) Tables and figures: Proportional to those for clinical and experimental studies.

5) Letter to the Editor

Letter to the Editor should include brief constructive comments that concern previously published articles and interesting cases. Letters to the Editor should be submitted no more than 3 months after the paper has been published.

- (1) Cover pages should be formatted in the same way as those of clinical research papers. The corresponding author should be the first author. A maximum of five authors is allowable.
- (2) The body text should not exceed 1,000 words and should have no more than 5 references. A figure or a table may be used.
- (3) Letters may be edited by the Editorial Board, and if necessary, responses by the author of the subject paper may be provided.

6) Editorial

Editorial is invited by the editorial committee and should be commentaries on articles recently published in the *J Evid-Based Pract*, and can be described in free style.

Author's checklist

- ☐ Manuscript in MS-WORD (DOC, DOCX) format.
- ☐ Double-spaced typing with 12-point font.
- ☐ Sequence of title page, abstract and keywords, introduction, methods, results, discussion, and conclusions, acknowledgments, references, tables, and figure legends. All pages and manuscript text with line should be numbered sequentially, starting from the abstract.
- ☐ Title page with article title, authors' full name(s) and affiliation(s), address for correspondence (including telephone number, e-mail address, and fax number), running title (less than 50 characters), and acknowledgments, if any.
- ☐ Abstract in structured format up to 300 words for original articles. Keywords (up to 5) from the MeSH list of Index Medicus.
- ☐ All table and figure numbers are found in the text.
- ☐ Figures as separate files, in TIFF, JPG, GIF, or PPT format.
- ☐ References listed in proper format. All references listed in the reference section are cited in the text and vice versa.

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