Health Science Literacy

FROM RESEARCH TO REVIEW

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acco learn

Chapter 1

General introduction



"These cabbage pills are just the ticket. I'm pretty sure I read that in The Lancet. Or was it Cosmopolitan?"

Learning objectives

- Understanding how you will develop the competences of health science literacy throughout this book.
- Appreciating the principles, process and the objective of evidence-based practice (EBP).
- Recognising the importance of research integrity, transparency, and responsible conduct in health science and clinical research.
- Becoming familiar with the structure of the book and the accompanying online learning platform (Sofia).

1.1 Introduction

Are you sometimes clueless about how to find the best answer to a clinical question? Do you find yourself unable to perform a quick and efficient search in scientific databases? Do you experience problems in selecting the most appropriate search terms (keywords) when looking for scientific papers? Are you looking for help to perform systematic literature searches? Are you considering developing a research protocol to answer clinical questions?

If you can answer "yes", at least once, to any of the questions above, this book is suited to you. By reading this book you will develop competences in searching and critically appraising scientific literature, both for clinical and scientific purposes. This book aims to develop a scientific and critical approach towards searching, interpreting and applying health science literature. It provides a step-by-step guide to searching scientific literature, critically appraising evidence and reporting findings through formats such as critically appraised topics (CATs) and systematic reviews. All these competences can be defined as **health science literacy**. In this updated edition, attention is also paid to the role of **artificial intelligence** (AI) in health sciences and research, including its opportunities, limitations, ethical considerations and responsible use in evidence-based practice and scientific reporting. This book explains the principles underlying these methodologies and provides practical guidance for applying them in clinical practice and research. The competences required for searching scientific literature will also enable the reader to use this information for the purpose of preparing a protocol for original research.

In addition to this textbook, the online learning platform Sofia provides examples, additional resources, links and self-assessment modules to support blended learning and feedback. References to Sofia throughout the book are indicated by a dedicated symbol in the margin.



1.2 Health science literacy

Health literacy is often referred to as "the degree to which individuals (lay people) have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions" [1]. More recent definitions focus on specific skills needed to navigate the health care system and the importance of clear communication between health care providers and their patients. Both health care providers and patients play important roles in health literacy [2].

Science literacy is referred to as the knowledge and understanding of science-related concepts and processes required for personal discourse and decision-making [3].

Health science literacy, as in the title of this book, focuses on the literacy of clinicians as well as academics (students included) in health sciences. Health science literacy extends beyond the ability to read scientific information. It includes competences such as critical thinking, literature searching, interpretation of evidence, scientific communication and evidence-informed decision-making. In the current digital era, health science literacy also includes the ability to critically evaluate information generated or supported by digital technologies and AI tools.

As illustrated in Figure 1.1, modern health science literacy requires more than simply accessing information. Health care professionals and researchers must be able to critically evaluate the quality, credibility and applicability of information originating from scientific literature, digital media and AI-assisted technologies. This requires a combination of methodological competences, critical thinking skills, ethical awareness and lifelong learning. This textbook guides readers from formulating searchable clinical questions to conducting **evidence-based practice**, **critically appraising literature**, participating in journal clubs, and conducting **systematic reviews** and original research.

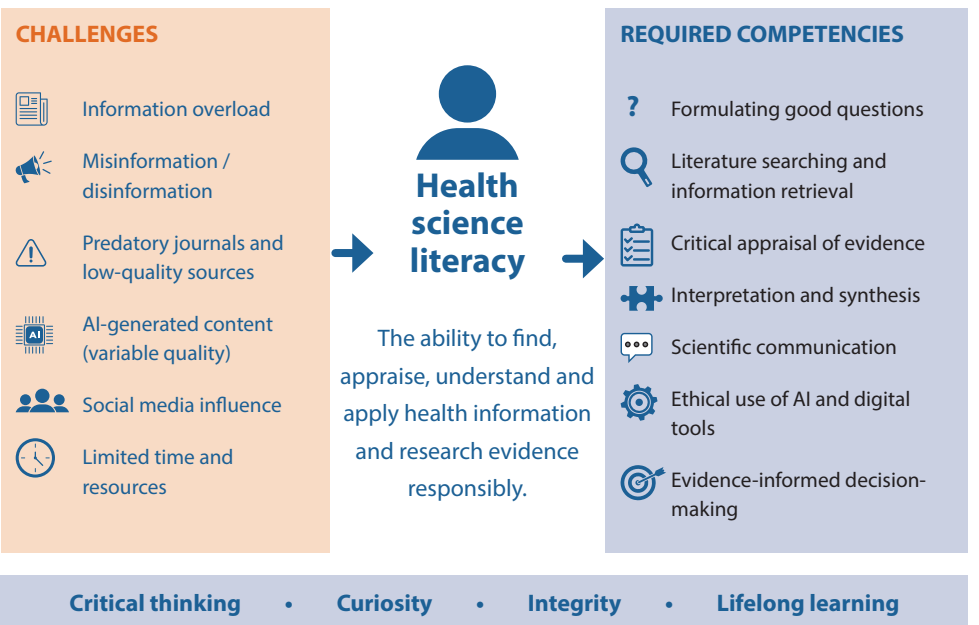


Figure 1.1. Health science literacy in a digital era.

1.3 Evidence-based practice (EBP)

1.3.1 Why EBP?

Observations have shown that, per patient, five questions are asked by clinicians. Of them, half could be answered immediately by the medical reports and 25% by consulting health science databases, e.g. MEDLINE [4]. Studies have shown that searching for and applying evidence may substantially influence clinical decision-making and improve diagnostic and therapeutic choices [5,6].

It is important that clinicians and managers can justify their treatment decisions with scientifically sound findings, rather than taking decisions based on:

- tradition... (This is how we usually do it);
- an anecdote (Ten years ago we had a similar case...);
- one article (According to that author, you must do this...);
- the opinion of an expert (In my experience, in these patients...);
- solely financial considerations.

Ideally, clinical decisions should be **evidence-based**. This implies making decisions based on a thorough search for, critical appraisal of, and implementation of the best available evidence.

1.3.2 Defining EBP

Evidence-based medicine (EBM) is the process of systematically reviewing, appraising and using clinical research findings to aid the delivery of optimum clinical care to patients [7]. The process of EBM should lead to evidence-based practice (EBP). EBP refers to the conscientious, explicit and judicious integration of the best available evidence, clinical expertise, patient values and contextual factors in health care decision-making [8].

EBP requires health care professionals to critically search for, appraise, interpret and apply relevant evidence in an ethical and transparent manner.

Increasingly, clinicians and researchers are also expected to critically evaluate the strengths and limitations of AI-assisted tools for literature searching, data interpretation and scientific writing.

To practise according to the principles of EBP, health care professionals must be able to identify relevant evidence, critically appraise its quality and applicability, and integrate

it with clinical expertise, patient values and preferences and contextual factors during shared decision-making.

EBP can therefore be defined as the conscientious, explicit and judicious integration of the best available evidence, clinical expertise, patient values and preferences and contextual factors in health care decision-making (Figure 1.2) [8, 9].

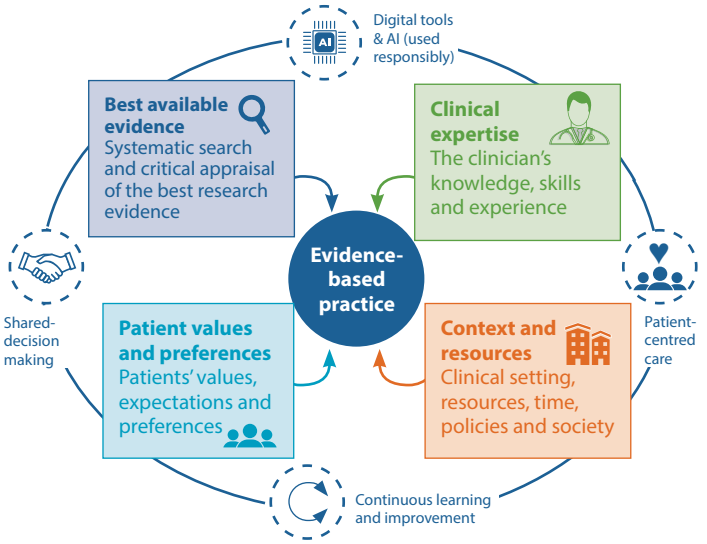


Figure 1.2. Modern model of EBP.

The definitions refer to the best external evidence based on the results of valid and relevant clinical research. Nonetheless, under similar medical conditions and in the light of the same evidence, clinicians may still take different decisions. Preferences, wishes and expectations of the well-informed patient or his/her representatives may vary and the clinical expertise of the clinician may influence the final decision.

The practice of EBP implies an integration of research evidence with clinical expertise to arrive at the best care and the best prevention.

1.3.3 Process of EBP

In health care it is expected from the clinician that he/she offers solid information about the causes of disease, the diagnosis of the patient, the prognosis of the patient and the anticipated effects of different therapeutic options with respect to the patients' views.

This knowledge about the impact of clinical actions is preferably based on findings of clinical research [10].

Therefore, applying EBP in clinical practice requires the use of a five-step method [8,11].

1. Translating the clinical problem into a searchable and answerable question.
2. Efficiently searching for the best evidence.
3. Critically appraising the evidence found, based on methodological quality and applicability in the clinical practice situation.
4. Integrating evidence with clinical expertise, patient preferences and contextual factors.
5. Regularly evaluating the quality of this process.

This process requires several skills, such as formulating a clear question, developing a search strategy and applying it to retrieve articles, critically reviewing articles and translating the results to clinical practice. All of that must be done in a conscientious, explicit and judicious way or, in other words, in a scientifically rigorous and ethically responsible way. The strategy and competences required for working according to the methodology of EBP (besides the clinical competences) are discussed in this book.

1.3.4 Required competences

1.3.4.1 Formulating the question

How to translate the clinical problem into a searchable and answerable question will be discussed in Chapter 4.

1.3.4.2 Efficiently searching the evidence

Modern health care professionals are confronted with an overwhelming and continuously expanding body of scientific literature of variable quality. Efficiently identifying, filtering and critically appraising relevant evidence has therefore become an essential competence in EBP [10]. AI tools may support literature searching and information synthesis, but users must remain aware of limitations such as hallucinations, bias, lack of transparency and incomplete/incorrect referencing.

Depending on the purpose of your search, you will preferentially access different sources and databases. To help you in that choice, we rely on the 6S pyramid that will be introduced in Chapter 5. The tool highlights sources of pre-appraised research evidence at the top of the pyramid to save health care professionals time critically appraising the literature. Evidence from sources lower in the pyramid must be critically appraised,

1.3.4.4 Implementation and evaluation

Unfortunately, most studies do not result in a summary of practical implementations to address questions such as "How does this result apply to this problem?" and "What is the best option, based on this study, for a specific problem at my clinic?"

Study findings must be made useful for the management of the individual patient. There are many factors that determine how outcomes can be translated to clinical practice. Findings are usually based on and applicable only for the "average" patient, which unfortunately does not exist. Thus, in the end, the practitioner will decide – in an informed and balanced manner with the patient which findings can be used or waived. So, health care remains an individualised process [10] that should be evaluated and adapted continuously.

Since this complete process is more time-consuming than just taking clinical decisions based on tradition or experience and to ensure quality and implementation of the EBP process, it can be desirable to record steps and findings of this process in a CAT (Chapter 10). This CAT can be disseminated to peers, so more clinicians can benefit from the efforts made and the efficacy and efficiency of a whole team or group of clinicians can be increased. Sharing these experiences in journal clubs will facilitate EBP.

1.4 The research process

Unlike research, EBP is not about developing new knowledge or validating existing knowledge. It is about translating the evidence and applying it to clinical decision-making. On the other hand, the purpose of conducting research is to generate new knowledge or to validate existing knowledge based on a theory. Research studies involve systematic, scientific inquiry to answer specific research questions or test hypotheses using disciplined, rigorous methods.

As presented in Figure 1.3, the process begins with compelling clinical or scientific questions about a particular topic. The first part of investigation involves a (systematic) comprehensive review of the literature to provide a rationale for the study. Identified knowledge gaps typically provide the rationale for developing a specific research question.

Next, a decision can be made towards the desired study design and the research protocol to answer the question. The first consideration is the target population, what will be measured, methods for data analysis, etc.

In a third step, the study is implemented and data are collected. Afterwards, in step four, data are analysed and interpreted and conclusions are drawn.

In the fifth step, researchers have the responsibility to share their findings with the appropriate audience so others can apply the information in clinical practice or for further research. Disseminating research findings can be performed through journal articles, congress presentations, etc.

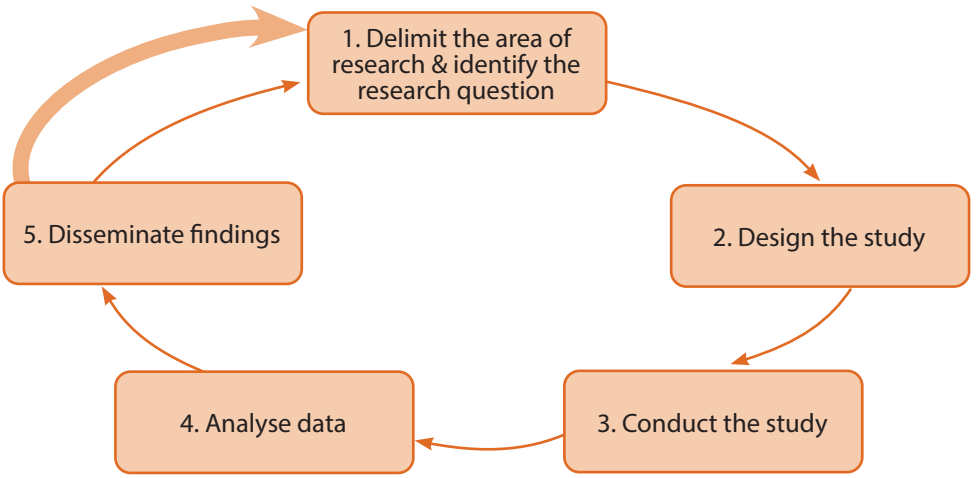


Figure 1.3. The research process and the interaction with evidence-based practice (EBP) [11].

Note that the research process is circular, and there is no dead end. The results of a study lead to new questions. Suggestions for further research can be made, either for researching new research questions, addressing limitations in the existing research or confirming results (in different samples or settings).

The loop also includes application of EBP. When research findings are applied in clinical practice, they can be tested in natural settings. This process will often lead to new questions, as we continue to deal with the uncertainties of practice [11].

1.5 Conducting a systematic review

A challenge for clinicians in maintaining up-to-date knowledge of their specialty, or learning about new areas, is the tremendous growth in medical literature and its increasing complexity. In response to this proliferation, there has been a major expansion of literature reviews, which aim to summarise all relevant information on the topic of

interest [12]. Systematic reviews use explicit and reproducible methods to identify, select, critically appraise and synthesise all relevant studies addressing a predefined research question [13]. Systematic reviews are generally considered among the strongest types of evidence when conducted rigorously and transparently (see also Chapter 3).

Therefore, this book combines practical guidance on EBP, literature searching, critical appraisal, systematic reviews and scientific reporting within a single integrated framework tailored to clinicians and academics.

As such, it offers the usual themes relevant for writing a review: a general introduction and glossary of terms often encountered in scientific literature (Chapter 2), an explanation of different study designs (Chapter 3), guidance on formulating research questions (Chapter 4), finding literature (Chapter 5), screening the search results (Chapter 6), assessing risk of bias (Chapter 7) and grading the evidence (Chapter 8). Chapter 11 integrates the knowledge and competences discussed throughout the previous chapters within the framework of international standards for systematic reviews, including the PRISMA statement [13] and the Cochrane Handbook [14]. Moreover, this chapter will focus on analysing and discussing the included literature to come to appropriate conclusions. Chapters 9 and 12 will guide researchers in reference management and writing skills to get the review published. Finally, Chapter 13 discusses the opportunities, limitations and responsible use of AI in health sciences, clinical practice and research.

The guidance has been written for those with an understanding of health care, but who are new to systematic reviews, and also for those with some experience who want to learn more. This guidance might also be useful to those who need to evaluate the quality of systematic reviews, including, for example, anyone with responsibility for implementing systematic review findings.

Given the broad scope of the topics covered and the needs of clinicians and researchers, a balance has been struck between breadth of coverage and the level of detail and discussion provided. Therefore, to support the process of undertaking a systematic review, frequent links and references are made to international sources and tools.

1.6 Animal research

Animal research continues to play an important role in biomedical and translational research, including the development and evaluation of new therapeutic interventions. Although the present textbook primarily focuses on human research and clinical studies, many general principles discussed throughout this book – such as rigorous study design, reduction of risk of bias, transparent reporting, systematic reviewing and research integrity – also apply to preclinical animal research.

At the same time, important differences exist between human and animal research, particularly regarding ethical frameworks, regulatory requirements, translational applicability and experimental methodology. Researchers conducting animal studies must therefore adhere to specific ethical guidelines and regulations governing animal welfare and responsible experimentation.

Regardless of the research setting, scientifically rigorous methods remain essential, including clearly formulated research questions, appropriate study design, transparent reporting and critical appraisal of evidence.

1.7 Conducting original research

New research should ideally build upon and be informed by existing evidence (gaps) identified through systematic literature review. As such, any new research activity should ideally be preceded and informed by a systematic review of the available evidence in order to increase the scientific and societal value of biomedical research, avoid unnecessary duplication and support the ethical use of resources, participants and animal models [15-19]. The new research activities should be appropriately designed to make sure they strengthen the available evidence base, while serving both clinicians and researchers. Therefore, we will also touch upon reporting original research (Chapter 12) to answer clinical questions, referring to the appropriate reporting guidelines.

1.8 Research integrity

Research integrity, evidence-based research and ethical behaviour lie at the heart of excellent science. They are indispensable to ensure the reliability of research results. Clinicians must be able to trust and build on the work of researchers. Also, researchers – providing knowledge and scientific expertise – must be trusted by society.

Research integrity refers to conducting and reporting research in a trustworthy, transparent, rigorous and ethically responsible manner. To ensure trustworthiness, the research is conducted in such a way that it allows others to have confidence and trust in the research methods and the findings of the research, which are described with honesty and accuracy. Hence, research integrity relates to both the scientific integrity of conducted research and to the professional integrity of researchers.

Increasingly, research integrity is also linked to the principles of open science, including transparency, reproducibility, preregistration of studies, appropriate data sharing and the use of standardised reporting guidelines. These practices aim to improve the credibility, reproducibility and societal value of scientific research.

Integrity is the personal quality of being honest and sincere, an intrinsic trustworthiness; a person of integrity says what he/she does, and does what he/she says, without hidden interests. Scientific or research integrity refers to the conduct of research in a fair and scientifically responsible manner. Scientific research only works if scientists also behave scientifically, i.e. behave in such a way that science moves forward. Research findings should be reported transparently and be open to critical evaluation and replication. A great deal of value is also attached to so-called academic freedom or the greatest possible independence of research within science; the results of the research must be looked at critically and the research must be fair and selfless. In principle, these standards are also enforced by the peer review system by which the scientific community checks itself.

The basic principles of research integrity are (Figure 1.4):

- respect;
- honesty, accuracy, reliability and transparency;
- objectivity;
- responsibility and accountability.



Figure 1.4. Principles of research integrity.

1.8.1 Respect

A researcher with scientific integrity is aware of everyone's interests in research and respects the interests of (patient) test subjects, test animals, colleagues and supervisors.

1.8.2 Honesty, accuracy, reliability and transparency

The scientific value stands or falls with the care with which research has been set up and carried out. An honest scientist works systematically and thinks ahead. He/she sets high standards for the quality of the execution of research and is nuanced and accurate when it comes to analysing research data and formulating conclusions.

Due care is also expressed in documenting all steps in the research process in a transparent and reproducible manner, allowing findings to be verified, critically evaluated and replicated by others. Transparent reporting, reproducibility, preregistration and appropriate data sharing of studies are increasingly considered essential components of trustworthy and high-quality scientific research.

Honest scientists acknowledge that they are indebted to other scientists and demonstrate this, among other things, by correctly citing the source.

1.8.3 Objectivity

An objective scientist strives to avoid bias in experimental design, data analysis, data interpretation, peer review, personnel decisions, grant writing and other aspects of research where objectivity is expected or required.

The importance of science takes precedence over personal professional interests and over financial gain. Examples of conflicts of interest are the interests of science, personal professional interests (e.g. ambition), interests of research funders and interests of test subjects and laboratory animals. Personal or financial interests that may affect research should be disclosed.

Also, the importance of scientific progress must be weighed against the rights and interests of test subjects and laboratory animals in scientific research and education.

1.8.4 Responsibility and accountability

Taking responsibility requires that an honest scientist has high-level knowledge and skills. They know the limits of their expertise. Researchers also remain accountable for the transparent, ethical and responsible use of digital and AI-assisted tools throughout the research process. This responsibility extends beyond the scientific research community. It also affects public trust in science, policy makers, (potential) research participants, and ultimately the quality and credibility of scientific research.

1.8.5 Violation of integrity

Violating these basic norms leads to research misconduct, which is the crux of inappropriate behaviour in science. It could mislead other researchers, and it may threaten individuals or society.

The increasing use of AI in education and research also increases concern regarding transparency, authorship, privacy, reproducibility, plagiarism, bias and responsible reporting. The use of AI-assisted tools should therefore be reported transparently, and

researchers remain fully responsible for the accuracy, integrity and reproducibility of their work.

Research misconduct can appear in many guises and can be defined as fabrication, falsification or plagiarism in proposing, performing or reviewing research, or in reporting research results.

- **Fabrication** is making up results and recording or reporting them as if they were real.
- **Falsification** is manipulating research processes or changing or omitting data.
- **Plagiarism** is the appropriation of another person's ideas, research results or words without giving appropriate credit. The precise wording of an idea or explanation or illustrative material (such as original figures and photographs, as well as lengthy tables) in textbooks or popular material is protected by copyright laws but nevertheless can be subject to plagiarism. Additionally, researchers should transparently report the use of AI-assisted tools and remain fully responsible for the accuracy, integrity and originality of their work.

1.8.6 Good clinical practice and responsible research conduct

In clinical and health research, principles of good clinical practice (GCP) are essential to ensure that studies are conducted ethically, safely, transparently and reliably. GCP includes adherence to approved protocols, appropriate informed consent procedures, accurate and traceable data collection, secure data management, protection of participant confidentiality and adequate documentation of all study procedures [20].

Proper documentation and transparent reporting are important not only for ethical and legal reasons, but also for scientific reproducibility, auditability and trustworthiness of research findings. Increasingly, these principles are closely linked to broader open science practices such as preregistration, reporting guidelines, data sharing and reproducible workflows.

Nowadays, formal GCP training and certification are increasingly required for researchers involved in certain types of clinical or human participant research, particularly in clinical trials and regulated research environments. Such training aims to ensure that researchers understand ethical responsibilities, participant safety, protocol adherence and principles of high-quality and trustworthy research conduct.

1.9 What is in it for me?

To conclude, the present book is written for both clinical and research purposes. Therefore, it can be used by different target populations: academics, clinicians, researchers, educators, etc. To give a clear overview and to indicate where specific information can be retrieved, Table 1.1 gives the structure of the book.

Chapter	Clinical questions addressed	Purpose for researchers
2. Glossary	What do all those methodological terms in articles mean?	What are the definitions of certain scientific terms and how should I take these into account in my research plan?
3. Study designs	Which different study designs exist? Which clinical information is provided by a certain design?	What is the construction of different study designs? What type of design is preferred in relation to a specific research question?
4. Searchable question (PICOST/SPIDER)	How do I translate my clinical problem to a searchable question? How can the PICOST/SPIDER structure help me to define search terms?	How do I formulate an appropriate research question? How can the PICOST/SPIDER structure help me to define search terms?
5. Searching databases	How can I search efficiently for literature applicable to my clinical practice, including the use of Boolean operators?	How do I develop my systematic and exhaustive search strategy, including the appropriate use of Boolean operators?
6. Eligibility criteria	How do I select the most appropriate articles for my case?	How do I perform a standardised and reproducible screening of the literature, with appropriate sensitivity and specificity?
7. Risk of bias and quality in research	How credible are the results of a certain study? Should I trust the results?	How should I assess the risk of bias in articles in a transparent and in-depth manner and appraise the quality of the study?

8. Grading the evidence	How strong is the conclusion of a study?	How should I weigh study design and risk of bias?
9. Reference management	How can I store articles and refer to them in texts?	How can I create a library of the included articles for my systematic review and use instant reference formatting when writing my review?
10. CAT	How can I report the search responses to my clinical question, to disseminate it to my peers? How can I contribute to journal clubs meaningfully, to increase EBM in clinical practice?	
11. Systematic review	What do the findings of a systematic review tell me?	How can I undertake a standardised and qualitative systematic review? How do I get started on data extraction? How can I analyse and synthesise my data? How should I write the discussion and conclusion sections of my review?
12. Writing tips	How can I communicate evidence clearly to colleagues and patients?	How should I write my article to get it published? Where should I publish my data? Which pitfalls should be avoided?
13. Use of AI in health science literacy	How can AI support evidence-based clinical practice and health science? What are the opportunities and limitations of AI in clinical decision-making and health science? How can clinicians and researchers critically and responsibly use AI tools?	How can I support literature searching, screening, data extraction, scientific writing and data analysis? What are the risks and limitations of AI in research? How can AI be used transparently, ethically and responsibly in scientific research and reporting?

Table 1.1. Overview of the book.



Practice your knowledge about this chapter on Sofia.

1.10 References

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