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RESEARCH ARTICLE

Concepts of Health, Disease, Overdiagnosis and Defensive Medicine in Relation to Clinical Practice

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ABSTRACT

Health, disease, overdiagnosis and defensive medicine are interrelated complex concepts that lack formal definitions and a uniform holistic perspective. Functional definitions of these concepts are context-specific and differ in relation to clinical practice, research, medical science and health insurance. In the context of clinical practice that is the focus of this review, having no clear working definitions of health, disease, overdiagnosis and defensive medicine is essential for distinguishing people who need medical intervention from those who do not, for formulating accurate diagnosis and treatment options, and for improving professional communication between clinicians and between clinicians and their patients.

The purpose of this narrative review is to promote the understanding of the concepts of health, disease, overdiagnosis, defensive medicine and their interrelation in the context of clinical practice, with the view of enhancing the quality of healthcare services.

Keywords: over-testing, diagnosis, overdiagnosis, disease, pseudo-disease, health, disease mongering, defensive medicine, bio-function, normality, naturalism, normativism

Introduction

The quality of healthcare services is determined by the benefits of treatment outcomes, by adherence to patient safety principles, and by the patient's experiential value of the healthcare service.[1] Diagnostic errors, excessive diagnostic tests and specialist referrals, and overscreening and overdiagnosis are unwarranted clinical practice eventualities that negatively impact the quality of healthcare services and the patient's wellbeing.[2, 3] As cognitive, emotional, educational, social, cultural and environmental factors influence the way that health-related values, needs and experiences are perceived by individuals, it is essential that these patient-specific health perspectives be considered when clinical decisions are formulated.[4]

Defining 'health' and 'disease' is complex and context specific, and thus the definition varies according to the practical function of the context (i.e. clinical practice, medical science, health insurance).[5] In the context of clinical practice, having a clear functional definition of health and disease is important for distinguishing people who need medical attention from those who do not; for formulating an accurate diagnosis and an appropriate treatment plan and for preventing overdiagnosis and overtreatment;[6] and for serving as a safeguard against disease mongering and against the current trend of medicalizing non-pathological everyday life experiences and human difficulties and conditions.[6-8]

There are different concepts of health and disease in the context of clinical practice. In this article, we refer to health as a dynamic, complex adaptive state, characterised by physical and mental functionality and a sense of wellbeing, that enables self-fulfilment, self-realization and effective self-management of everyday tasks, demands and stressors;[4, 6, 9-12] and to disease as biological abnormalities that are associated with functional impairment and have a significant probability of causing notable harm.[11,13] The conceptual framework and operative definition of health should address the effectivity of one's resilience, coping and adaptive capacities in relation to maintaining and restoring homeostasis and a sense of wellbeing.[12] Both health and disease cannot be dichotomised into 'all-or-nothing' binary opposites, but are rather a relative, dynamic state of wellbeing.[6]

Overdiagnosis refers to clinical cases in which insignificant bio-functional abnormalities have been detected, but the probability of these abnormalities to cause harm is minimal;[13]and to diseases with mild signs and symptoms that have been correctly diagnosed for what they are according to current standard criteria (guidelines) but nevertheless will not progress to cause harm even in the absence of treatment. Moreover, in cases of overdiagnosis, appropriate treatment not only has a low likelihood to clinically benefit the patient, but may paradoxically cause harm.[14-17]

Disease mongering refers to the practice of widening diagnostic thresholds and criteria of existing diseases, of framing risk factors as diseases, of regarding functionally insignificant biological abnormalities as pathologies that require interventions, and setting up new categories of illnesses, risk factors and 'pseudo-diseases'. This process is driven by many parties including pharmaceutical industries, manufacturers of medical equipment and public and private interest groups, with the aim of promoting unwarranted diagnosis (overdiagnosis) and treatment (overtreatment); and it is managed by lobbying, marketing, and creating favourable public opinion, with the purpose of generating economical profit and/or political influence.[7, 18]

Owing to the availability of, and accessibility to digital information technologies, the public is exposed to the latest information about health-related issues such as diagnostic screening, innovative diagnostic research and tests, genetic data that can improve risk prediction for common chronic diseases, and to recently developed therapies.[19] Consequently, persons use this information to form their own judgements and perspectives about health issues, in accordance with their personal preferences and needs. These personal judgements and perspectives are influenced by age and gender, and by socioeconomical, cultural and environmental factors, thereby making the concepts of health and disease a relative, personal, situation-specific phenomenon. Since perceptions of health concepts and values greatly differ among people, clinical care must be personalised as much as possible.[4, 10]

Owing to the increased public awareness and interest regarding health issues, people often expect and request a diagnosis for signs and symptoms they experience even if those are functionally insignificant. This, together with the use of increasing sensitive diagnostic testing techniques that can detect clinically inconsequential minute biochemical abnormalities, may initiate a diagnostic process that may lead to overdiagnosis and overtreatment.[8, 20]

The purpose of this article is to shed light on some aspects of the complex concepts of overdiagnosis,

health and disease with the view to promote consensus building about binding defining criteria for overdiagnosis which in turn may facilitate formulation of strategies to reduce the burden of this phenomenon. The information for this article was obtained from searches of MEDLINE and Pubmed using the search terms overdiagnosis, overtesting, health, disease, defensive medicine, clinical uncertainty, naturalism and normativism; and of references from relevant articles that were deemed pertinent. English language academic papers, but not those published in a language other than English, were scrutinised for the writing of this narrative review.

Overtesting

Overtesting refers to ordering non-recommended screening tests in asymptomatic people who are not at increased risk, or to utilization of tests that are not indicated for diagnosing patients with specific signs or symptoms.[21] Such tests are not likely to contribute useful information for the clinical decision-making process and for improving treatment outcome, but have the capacity to detect clinically insignificant bio-functional abnormalities that prompt futile interventions.[21]

Cancer screening tests are employed with the purpose to identify biologically aggressive cancers at an early stage of disease when curative interventions are most effective. However, screening tests also detect indolent clinically inconsequential cancers that would not cause death or harm during the patient's lifetime (cases of overdiagnosis). The estimates of cancer overdiagnosis varies widely between different types of cancer; and between different studies of the same cancer type, in accordance with the population studied, diagnostic criteria and sample size.[22, 23] However, it appears that cancer screening for prostate (PSA testing), lung (low dose CT) and breast (mammography) are most frequently associated with overdiagnosis.[22, 24]

Overtesting and consequent overdiagnosis are driven by practicing defensive medicine, by lack of knowledge or confidence on the part of the clinician, by financial incentive and profit and by one's motivation to detect diseases early in their natural course at a subclinical stage.[21] Defensive medicine refers to the clinical practice of ordering diagnostic tests, specialist referrals, consultations and procedures of questionable value that are not medically indicated owing to fear of, and to safeguard from malpractice liability claims (Figure 1).[25]

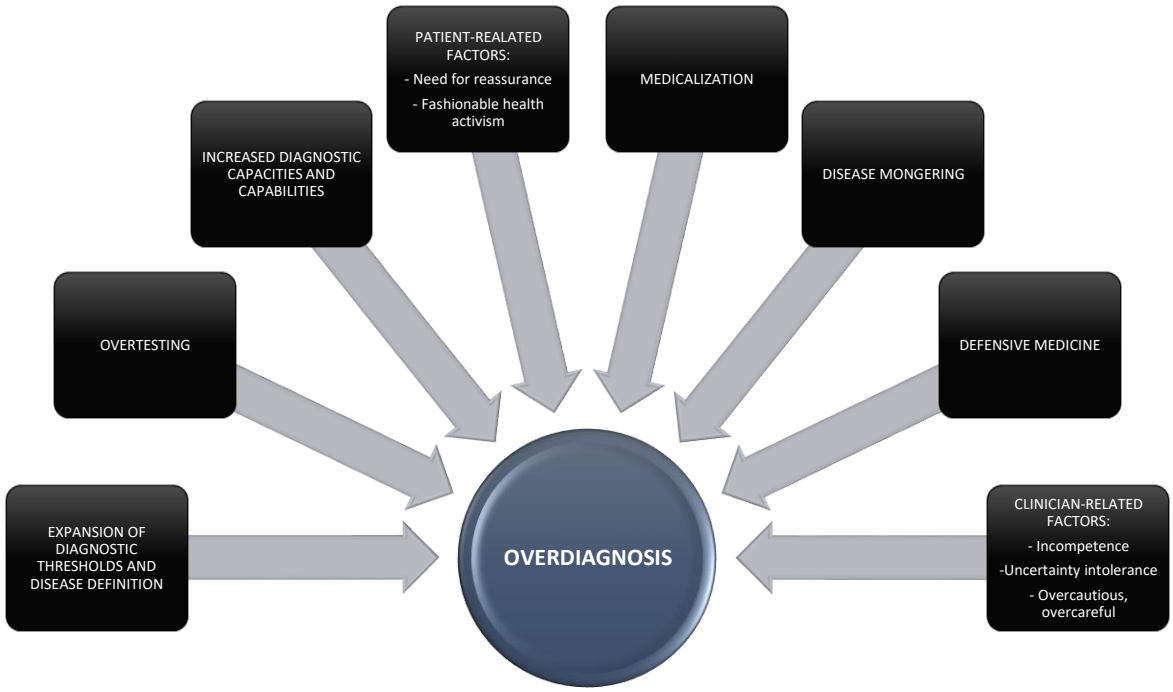

Figure 1: Drivers of Overdiagnosis. Overdiagnosis is a complex concept and in the context of clinical practice it is driven by a collection of agents that may operate in collaboration to promote overdiagnosis.[8]

Not infrequently overtesting is associated with false positive test results, with a low yield of beneficial data, with unwarranted anxiety experienced by the patient,[8, 21, 26, 27] and with nacebo effects driven by negative expectation generated by the overtesting and overdiagnosis.[14] Furthermore, overtesting with its consequent ineffective overdiagnosis generates unnecessary clinical follow-up appointments and additional tests which expose the patient to significant financial costs; and the clinician to futile work overload.[26]

Thus, before ordering a diagnostic test, the clinician should assess the possible harmful and beneficial effects that the given diagnostic test may lead to. This together with the patient's relevant value-judgements will influence the clinical decision whether or not to order a specific test. In the event of a bio-functional abnormality been detected, it has to be carefully evaluated in relation to its potential to cause significant harm. This information is important for the formulation of an accurate diagnosis and prevention of overdiagnosis.[26]

Overdiagnosis

A diagnosis is a label that distinctively characterises a particular disease in terms of aetiology, risk factors, pathogenesis, treatment and prognosis; and is based on information gathered from the patient's physical examination, health history and diagnostic test results.[17, 28] On the other hand, overdiagnosis may be viewed as the act of labelling (diagnosing) a bio-functional abnormality that does not cause harm as a disease;[29] and also refers to a correct diagnosis formulated on well-established diagnostic criteria, but that nevertheless does not generate health benefits, and may even cause harm.[14]

Diagnostic methods using medical imaging, genetic tests, pathology tests and other medical laboratory tests are critical for detecting disease-related determinants and for formulating a diagnosis. In turn, an accurate diagnosis enables clinicians to compose a treatment plan and to estimate treatment outcomes. Although newly developed innovative technologies make clinical diagnosis more effective and predictive, this increase in diagnostic capacities and capabilities is accompanied by detection of minor anatomical, biochemical, physiological and genomic abnormalities, some of which are clinically insignificant.[6, 16]

Confounding risk factors and precursors of diseases with the disease itself, and ill-defined boundaries between bio-functional abnormalities that constitute disease and those that do not, are important circumstances that contribute to overdiagnosis.[13, 26]

With regard to risk factors of a given disease, the clinician should be cognisant of the differences between relative risks and absolute risks, and between population (epidemiological) risk and the risk of individuals within those populations; and of the inability to estimate with confidence the individual risk based on the evident population risk.[26, 30, 31] Having a good understanding about these issues may reduce the frequency of the overdiagnosis.

Thus, overdiagnosis can be viewed as a complex concept that lacks a formal definition and an accepted holistic view;[14, 29, 32] and is inherent to certain screening and diagnostic processes employed in some clinical disciplines.[20] Owing to the absence of defining threshold diagnostic criteria for, and of a unifying definition of 'overdiagnosis', the epidemiological data about the overdiagnosis phenomenon are scarce.[3]

Defining Health and Disease

'Health' and 'disease' are usually defined based on either naturalistic or normative theories, or by a hybrid naturalistic-normative approach.[4, 33] The naturalistic approach is free of subjective value-judgements and is based on objective, statistically normal, bio-functional values, and is driven by scientific data. According to the naturalistic biostatistical theory, health reflects a biological state of statistically normal functional activity, while disease is a state of biological statistically abnormal functional activity. In this context, the statistical measurements are evaluated relative to an established reference class.[34]

In contrast, the normative approach is based on subjective value-judgements about one's physical, mental and social functionality and wellbeing, with health viewed as a valuable or desirable state, and disease as a disvalued state that should be avoided, regardless whether or not the state is characterised by true psycho/bio-dysfunctionality. The hybrid approach deems disease as a disvalued and undesirable bio-dysfunctional harmful state, thus combining concepts from both the naturalistic and normative theories.[11, 33]

In healthcare related disciplines, a reference range is a set of values that are considered statistically normal in healthy people, and indicative of functional biological activity; and values outside this specific reference range are considered statistically abnormal.[35] Reference values and best available evidence-based information obtained from randomised and meta-analytical studies are essential to the diagnostic process, and thereby improve clinical care for average, randomised

patients, but nevertheless may not be beneficial for patients who do not fit the characteristics of the 'average' patient. This is because 'generalized best' scientific knowledge does not include important information about patient-specific characteristics, including co-morbidities, risk factors, clinical and biopathological data, response to prior treatment, compliance, psychological status, social support or lifestyle.[36, 37] Thus, for a particular patient, values outside the reference range do not necessarily indicate a biologically significant dysfunction, or a disease that requires intervention.

Although the naturalistic theory defines disease based on objective biological and bio-functional criteria, the boundaries between bio-functional normality, insignificant bio-functional abnormality, and significant meaningful bio-functional abnormalities that drive the pathogenesis of particular diseases are not well defined. This together with the fact that there are no definitive diagnostic thresholds for many diseases may explain the not uncommon occurrence of overdiagnosis.[34]

Furthermore, as the clinical and pathological features of specific diseases are not unique and generally do not show distinct boundaries, clinical reasoning, judgement and expertise are required to determine the definite diagnostic threshold of a particular disease. Since this clinician-specific cognitive diagnostic process is subjective, it is prone to cognitive biases and this may lead to overdiagnosis.[37, 38]

The naturalistic concept of health and disease raises the question whether or not biological abnormalities that induce only mild functional impairment, do not cause harm and do not interfere with the patients experience of wellbeing should be considered as diseases that require interventions, or should be regarded as unwarranted overdiagnosis.

In relation to the normative concept, health and disease should be viewed as a complex, personal, experiential situation-specific phenomenon that is influenced by social, cultural and environmental factors[9,10] and is determined by conceptual abstractions such as harm, suffering, desirability/ undesirability and value/disvalue.[37]

Defensive Medicine

All patients will experience at least one diagnostic error (either inappropriately delayed, wrong or missed) during their lifetime. Some of these diagnostic errors bear harmful health consequences and are a common source of malpractice claims.[2] In clinical practice settings, diagnostic errors are unavoidable because of the complexity of the diagnostic process which is associated with many inherent elements of uncertainty and with common cognitive biases affecting the clinician's reasoning, judgement and decision-making (Figure 2).[36]

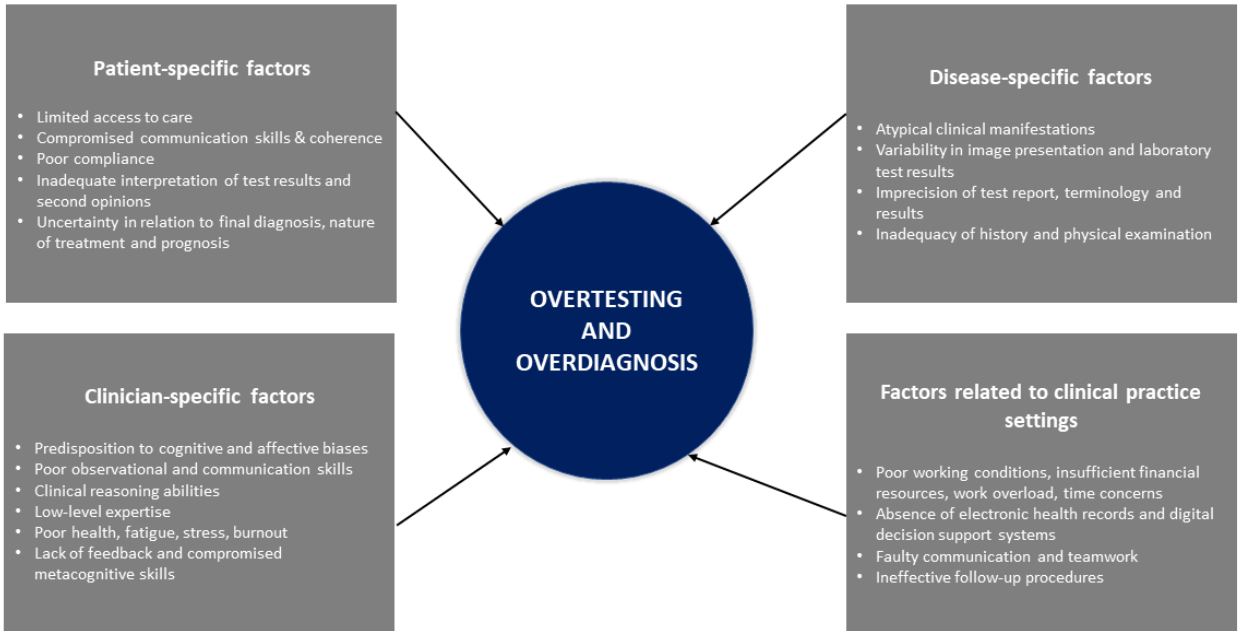

Figure2: Some factors influencing overdiagnosis and overtesting.
The diagnostic process is complex and is characterised by dynamic adaptive interactions between clinical settings-, clinician-, patient- and disease-specific factors in the background on inherent uncertainty. This complexity is difficult to control and consequently predisposes to overtesting and overdiagnosis. Adapted from Croskerry 2018 {[46]}

The process of clinical practice decision-making is characterised by multiple complex issues that are difficult to resolve, including control of confounding factors, distinction between effects of direct and indirect factors influencing clinical decision-making, the efficacy with which experimental and non-experimental relevant data are integrated by the clinician and the subjective estimation of treatment outcomes and long-term prognosis.[39]

Other factors that may complicate the process of clinical decision-making and may lead to overdiagnosis include the equivocal and dynamic nature of the patient's health problem, the complexity of the healthcare science and the clinician's competency and susceptibility to cognitive biases (Figure 2).[36, 40] All these contribute to the inherent uncertainty of everyday clinical practice, and dictates the need for utilizing diagnostic tests and specialist referrals. Clinical practice elements of uncertainty are the leading cause of diagnostic errors, overdiagnosis and overtreatment, and these may negatively impact the quality of healthcare services, and the patient's physical and mental wellbeing; and typically raise the cost of healthcare services.[40]

As a result of the clinician's fear of committing diagnostic errors and facing their potential adverse legal consequences, and of failing to satisfy the patient's need for reassurance, some clinicians occasionally order excessive diagnostic tests and specialist referrals. These are unwarranted because more often than not, they do not provide any useful information to improve the clinician's judgement and decision-making processes and to benefit clinical treatment outcomes.[2, 26]

Moreover, triggering of additional questionable diagnostic tests and specialist referrals often results in identification of incidental irrelevant minute bio-functional abnormalities. These clinically insignificant findings may initiate overdiagnosis and overtreatment that sometimes are more harmful than beneficial.[2, 20, 26] Thus, defensive clinical practice using unwarranted excessive diagnostic testing and specialist referrals with the view of reducing the risk of diagnostic errors, malpractice litigation and patient dissatisfaction are leading drivers of overdiagnosis and overtreatment (Figure 1).[15-17]

THE WAY FORWARD

As there are no universally accepted binding criteria for overdiagnosis, and as the criteria used are variable and often vague and clinically problematic to apply, it is difficult with any accuracy or consistency to evaluate and measure the frequency of occurrence of overdiagnosis, and subsequently to determine the epidemiological features of this phenomenon. As overdiagnosis has a negative impact on the quality of healthcare services, on a patients physical and mental wellbeing and on financial resources of healthcare systems, it may be prudent to recognise the overdiagnosis phenomenon as a distinct healthcare problem. This may promote consensus building in relation to binding defining criteria for overdiagnosis which in turn may facilitate documentation and accumulation of evidence-based epidemiological data, and may enable public health professionals to formulate strategies to reduce this health burden.[3, 32]

Effective integration of bioinformatics and of clinical data and information into clinically relevant knowledge and effective use of electronic medical/health records and digital decision support systems may have the capacity to enhance accurate clinical decision-making;[41] and to provide important, beneficial knowledge that is directly applicable to patient-specific diagnosis, treatment options, treatment outcome and prognosis. These digital tools have the capacity to flag adverse drug-to-drug interactions, errors in pharmaceutical dosing and drug allergies, and about alarming laboratory results;[41-43] and thus may reduce the frequency of overtesting, overdiagnosis and diagnostic errors (Figure 3).[44]

Acquiring and effectively utilizing relevant knowledge base, clinical skill and adaptive expertise; optimizing the process of critical thinking and of clinical reasoning; mitigating relevant cognitive biases; and improving clinician-patient communications, and communications among the diagnostic team members, all have the potential to improve professional competence and expertise, and to minimise overtesting, overdiagnosis and diagnostic errors (Figure 3).[42, 43, 45-47]

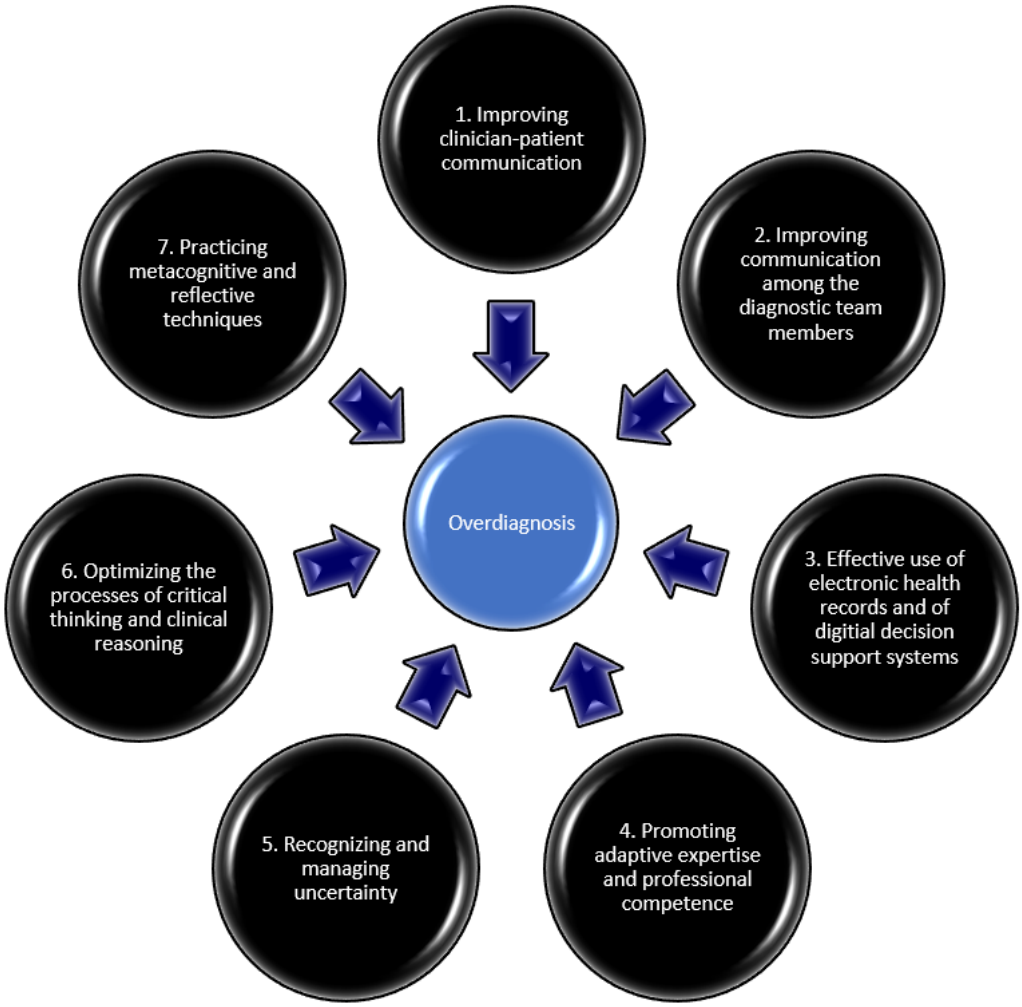

Figure 3: Some measures that may reduce the burden of overdiagnosis. Adapted from Graber et al., 2018[42], Graber et al., 2022[43]

Further research is needed to develop tools that can predict which clinically insignificant bio-functional abnormality is likely to evolve into disease causing harm; and with regard to cancer screening, to identify genetic markers that have the capacity to distinguish biologically aggressive, rapidly progressing cancers from indolent, slow growing ones.[23]

In order to increase the awareness and knowledge about the complex interactions between health, disease and overdiagnosis, these issues, both on academic and practical levels, should be included in the curricula of undergraduate and postgraduate healthcare students, and feature at continuous education courses and relevant healthcare conferences.[15]

Further research is also necessary to determine the best clinical training and educational methods that may improve clinical judgement and diagnostic reasoning; and to determine which are the risk factors associated with overdiagnosis and what strategies and interventions are best in reducing the frequency of overdiagnosis and in managing clinical uncertainties (Figure 3).

Conclusion

- The concepts of overdiagnosis, health and disease are complex, context-specific, interrelated, and open to interpretation.
- Accepted operational definitions of health, disease and overdiagnosis need to be formulated in order to improve professional communication, to facilitate research and for developing methods to assess the quality of life and sense of wellbeing of both patients and clinicians.
- Before ordering diagnostic tests, the clinician should estimate the strength of the association between the variables of interest and the risk of disease, and should avoid tests related to a shotgun approach.
- Effective integration by the clinician of evidence-based clinical practice guidelines, of

his/her own clinical experience, of expert and second opinions and of patient-specific health-related values and needs, is essential for avoiding overdiagnosis.

- Effective use of information technologies and of electronic clinical and administrative data bases related to patients can reduce the need for excessive diagnostic testing and overscreening, and improve the efficacy of the clinical decision-making process, thus reducing the occurrence of overdiagnosis.

Declarations

Authors Contribution

LF designed and conceptualized the article. SF, RAGK and GF done the literature search. LF, RAGK, PH, SF and GF done the literature review. All authors edited the final version of the article. All authors read and approved the final version of the article.

Data Availibility

The data supporting this narrative review are from previously reported studies and datasets, which have been cited.

Competing Interests

The authors declare that there is no conflict of interest.

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Ethical Approval

This is a review article. No human or animals were involved; therefore, no ethical approval was needed.

Consent For Publication

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