# The economics of diagnostic safety

## SETTING THE SCENE

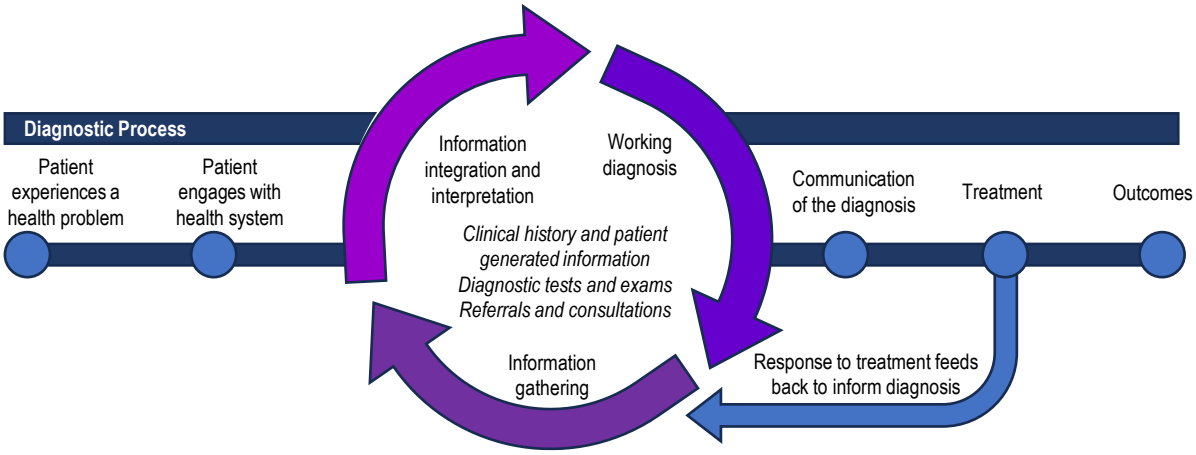
September 2024 http://www.oecd.org/

## Key findings

- Diagnosis is a foundational process of the practice of medicine. The correct and timely identification of a health condition is a first step in ensuring that it is properly treated or managed. Most people will experience at least one diagnostic error in their lifetime, sometimes resulting in severe patient harm. Up to 80% of all harm caused by delayed or misdiagnosis could be preventable. Findings from the United Kingdom show that asthma overdiagnosis and underdiagnosis among children were potentially as high as 15% and 40% respectively. Globally, up to 70% of persons with chronic obstructive pulmonary disease (COPD) or asthma do not receive a formal diagnosis of the condition.
- A growing number of tests, tools, and systems are now available across healthcare settings to help patients and providers identify health problems, resulting in increased use of diagnostic tests and procedures. Despite new tools and technology, health systems still fail to identify health conditions due to poor clinical skills, decision making, organisation and integration of care deliver and limitations of information systems in a correct and timely way. This can lead to duplication and unnecessary care. In the Netherlands, repeated laboratory testing of normal test results occurred in up to 85% of hospitalised patients. Costs associated with false-positive mammograms and breast cancer overdiagnoses exceed USD 4 billion annually in the United States.
- Diagnosis is not a one-off activity, but an iterative and complex ongoing process of information gathering and evaluation. Risk is intrinsic to the process of diagnosis, and harm sometimes occurs despite high quality care. Deficits in health system design and governance, clinical environments, and individual provider competencies can drive poor diagnostic outcomes, while improvements can influence better diagnostic performance. These concepts will be further explored in a forthcoming OECD report to be published in 2025.

The diagnostic process (see Figure 1) is often iterative, meaning initial assessments may not yield a definitive answer but instead guide further investigation. Not arriving at the correct diagnosis immediately isn't always an error, but rather a step in the ongoing process of refining and narrowing down possible causes. Despite this, the complexity, fragmentation, and dynamism of the process can inflate the risk of errors, delays, and associated harms.

### Figure 1. The diagnostic process is iterative by nature




Source: Adapted from Balogh et al. (2015[1]), "Improving Diagnosis in Health Care", https://doi.org/10.17226/21794.

Not only are there potential harms from a delayed or incorrect diagnosis, with each use of diagnostic test or treatment, each assessment can increase the potential for false positives and ambiguous or slightly abnormal test results that lead to further diagnostic testing or unnecessary treatment. At the clinical level, a delayed or wrong diagnosis can result in physical and psychological harm to patients. It also impacts care delivery at the organisational level, typically in the form of duplication, rework and lengthier care trajectories. At the system level, a delayed or wrong diagnosis aggregates to suboptimal safety and quality, manifesting in wasted resources and poorer health outcomes.

A growing number of tests, tools, and systems are now available across healthcare settings to help patients and providers identify health problems. However, despite new tools and technologies, health systems still often fail to correctly identify health problems due to factors ranging from diagnostic skills and cognitive bias to the organisation of care and its supporting information systems. As a result, most people will experience at least one diagnostic error in their lifetime, sometimes resulting in severe harm (Balogh et al., 2015[1]). Up to 80% of harm caused by delayed or wrong diagnosis could be preventable (Auraaen, Slawomirski and Klazinga, 2018[2]). For policy makers, low quality diagnostic practices should be an area of focus to prevent wasted healthcare resources and excess morbidity and mortality that may have been avoidable if patients had received a timely, correct diagnoses.

## The economics of patient safety and the focus on diagnostic safety

Investing in the prevention of harm, while incurring modest costs in the short term, creates value through reducing the need to address future adverse events (failure costs), and through improving patient outcomes. In recent years, the OECD has advanced on work to explore the role of policy levers for improving patient safety through the lens of economic theory (see Box 1). A key part of this work has been quantifying the costs of patient safety lapses in health systems, and motivating investment in safer health systems. Work began, primarily focusing on hospital care, but has been expanded into detailed assessments of other settings and other aspects of safe care.

### Box 1. OECD Economics of Patient Safety Reports

- Kendir, C., et al. (2023), "Patient engagement for patient safety: The why, what, and how of patient engagement for improving patient safety", *OECD Health Working Papers*, No. 159, OECD Publishing, Paris, https://doi.org/10.1787/5fa8df20-en.
- Slawomirski, L. and N. Klazinga (2022), "The economics of patient safety: From analysis to action", *OECD Health Working Papers*, No. 145, OECD Publishing, Paris, https://doi.org/10.1787/761f2da8-en.
- de Bienassis, K., et al. (2022), "The economics of medication safety: Improving medication safety through collective, real-time learning", *OECD Health Working Papers*, No. 147, OECD Publishing, Paris, https://doi.org/10.1787/9a933261-en.
- de Bienassis, K., L. Slawomirski and N. Klazinga (2021), "The economics of patient safety Part IV: Safety in the workplace: Occupational safety as the bedrock of resilient health systems", *OECD Health Working Papers*, No. 130, OECD Publishing, Paris, https://doi.org/10.1787/b25b8c39-en.
- de Bienassis, K., A. Llena-Nozal and N. Klazinga (2020), "The economics of patient safety Part III: Long-term care: Valuing safety for the long haul", *OECD Health Working Papers*, No. 121, OECD Publishing, Paris, https://doi.org/10.1787/be07475c-en.
- Auraaen, A., L. Slawomirski and N. Klazinga (2018), "The economics of patient safety in primary and ambulatory care: Flying blind", *OECD Health Working Papers*, No. 106, OECD Publishing, Paris, https://doi.org/10.1787/baf425ad-en.
- OECD (2020), "Measuring Patient Safety: Opening the Black Box", www.oecd.org/health/health-systems/Measuring-Patient-Safety-April-2018.pdf.
- Slawomirski, L., A. Auraaen and N. Klazinga (2017), "The economics of patient safety: Strengthening a value-based approach to reducing patient harm at national level", *OECD Health Working Papers*, No. 96, OECD Publishing, Paris, https://doi.org/10.1787/5a9858cd-en.

Findings of the reports on hospital, primary, and long-term care suggest that the global burden of healthcare-related harm continues to be of similar magnitude to many communicable and non-communicable diseases. The OECD estimates the direct cost of unsafe care on to health budgets approaches 13% of healthcare spending (about USD 606 billion a year or just over 1% of the combined economic output of OECD countries) (Slawomirski and Klazinga, 2022[3]). The economics of diagnostic care can be assessed from several angles, including the costs of additional service use caused by unsafe or untimely diagnostic care, legal costs, long-term costs related to affected individuals, and the return on investment of improvements, as well as the trade-offs between the volume of diagnostic testing and improved outcomes.

## Medical diagnosis: Embracing clinical, technological and organisational complexity

Patient harm related to diagnostic error can result from a single incident. It can also develop over time through delayed or incorrect diagnosis. Diagnosis is not a one-off activity, but an iterative and complex ongoing process of information gathering and evaluation. It is also dependent on statistical probabilities, the distribution of a condition in a population and the likelihood that an individual has it. As more is understood about a patient's health condition through clinical histories, exams, tests, and consultations, the diagnostic possibilities are narrowed. Once a diagnosis is made and appropriate treatment is commenced, information on the treatment response feeds back into the diagnostic cycle, shedding further

light on the accuracy of the initial diagnosis. Diagnostic tools are routinely used in healthcare provision to inform treatment; however, many of these tools (and the providers who prescribe and assess them) are subject to intrinsic error, or erroneous interpretation of the results.

The complexity of diagnosis is an important contextual factor that can impact quality of care (Ben-Assuli et al., 2019[4]). Diagnosis of many common conditions, including sepsis (Angus et al., 2016[5]), irritable bowel syndrome (Enck et al., 2016[6]), asthma (Lo et al., 2018[7]), Attention-Deficit/Hyperactivity Disorder (ADHD) and long-COVID syndrome (see Box 2), still lack consensus on agreed upon classifications and diagnosis is not always obvious. Other conditions, such as tuberculosis, cysts, and tumours, are frequently misdiagnosed for a wide variety of other (incorrect) conditions (Li et al., 2020[8]).

### Box 2. A diagnostic challenge for patients and healthcare systems: COVID-19 infection and long-COVID

In the era of the COVID-19 pandemic, the scale of increased use of laboratory test in home settings was unprecedented. As of 2023, the self-testing market has been valued at almost USD 11 billion (Polaris, 2023[9]). This sizable market share has been supported by the scaled-up use of rapid diagnostic tests and self-administered sampling for COVID-19 outside of the clinical setting. While consumer testing kits have numerous benefits such as increased access, patient empowerment, lower costs, documentation of results and their use in the formal diagnostic process is still evolving.

A second diagnostic challenge relates to “long COVID”, i.e. the collection of symptoms that may develop or persist for over four weeks following the onset of a COVID-19 infection. Due to variation in clinical presentation, severity and duration of symptoms, incomplete understanding of the underlying pathogenesis, and lack of standardised criteria and diagnostic tools, long-COVID is especially challenging to diagnose (Espinosa Gonzalez and Suzuki, 2024[10]). The consequence for patients can be a delayed correct diagnosis of long-COVID or an inappropriate diagnostic label and associated clinical follow-up, with related negative occupational and functional impact on quality of life. An OECD project supported by the European Commission and in collaboration with WHO-Europe aims to build consensus among countries on the key needs and priorities of patients, health systems, and societies for long-COVID and to develop good practices, policies and systems to effectively address these. A specific focus is the evolution in epidemiology and clinical aspects of long-COVID, and its socio-economic implications.

Safety experts now largely agree that the traditional focus on measuring and learning from what goes wrong in healthcare should be complemented by a more proactive approach emphasising understanding and optimising *successful* practices and outcomes to improve overall safety and performance (Braithwaite, Wears and Hollnagel, 2015[11]; Hollnagel, Wears and Braithwaite, 2015[12]). In the context of diagnosis, this means learning from instances where diagnoses are correct and the diagnostic process functions as intended to facilitate the best outcomes for patients, or from where diagnostic safety has been improved through innovations in policy and practice. Given the emphasis on facilitating correct courses of action despite uncertainty, this approach seems tailor-made for diagnostic practice, which rarely (if ever) occurs under conditions where perfect information is available.

## Overview of key concepts

### *Diagnosis versus diagnostics*

Diagnosis and diagnostics, while related, refer to distinct concepts. Simply put, *diagnosis* is the process of identifying the presence of a disease or condition in a patient. Typically, the diagnostic process is informed by a variety of information sources, including the evaluation of symptoms by their care provider, patient and family histories, and the results of diagnostic tests. Historically, it has been thought of as a conclusion made by healthcare providers or a result after consideration of various investigations. While the label of diagnosis still functions to this end, diagnosis should be considered an iterative process, whereby conclusions are continually re-evaluated following the patient's health condition and their response to various treatments over time.

*Diagnostics* refer to the tools, methods, and procedures used to assist in determining a diagnosis. Many of the methods are based on technologies, including blood tests, imaging studies (e.g. magnetic resonance imaging (MRI), computed tomography (CT), or ultrasound), biopsies, and other medical tests. In areas where there are limited biomarkers for disease, such as mental health, standard diagnostic criteria can be used through psychological assessment and testing to determine if patient-reported symptoms fall within the definitions of mental health disorders.

Low accuracy of diagnostic tests can lead to both unnecessary care and stress (in the case of false positive diagnosis) or untimely diagnosis, potential disease progression, and delayed care (in the case of false negative diagnosis). Both sources of error impact health outcomes and can lead to potentially avoidable medical and legal costs for patients and health systems. Finally, cut-off thresholds used to determine presence or absence of disease are not in themselves binary, typically falling within a range, where a threshold is set based on optimising the statistical probability of correct diagnosis (i.e. true positive result).[1]

### *Overdiagnosis consumes healthcare resources, is costly and may induce patient harm*

The twin challenges of overdiagnosis and underdiagnosis, and resulting overuse and underuse of medical interventions, pose significant risks to patient outcomes and the sustainability of health systems. Overdiagnosis relates to the diagnosis of a health condition that won't result in any negative symptoms or problems for the patient. Often over diagnosed health conditions result from diagnostic tests and screening methods that detect abnormalities which may never progress or impact the individual's health. Systematic reviews have shown that there is substantial overuse of diagnostic testing present across healthcare settings, with substantial variation in use of similar diagnostic services (Müskens et al., 2022[13]). Overdiagnosis can lead to unnecessary treatments, anxiety, and healthcare costs, without providing any real benefit to the patient – and potentially exposing them to harm.

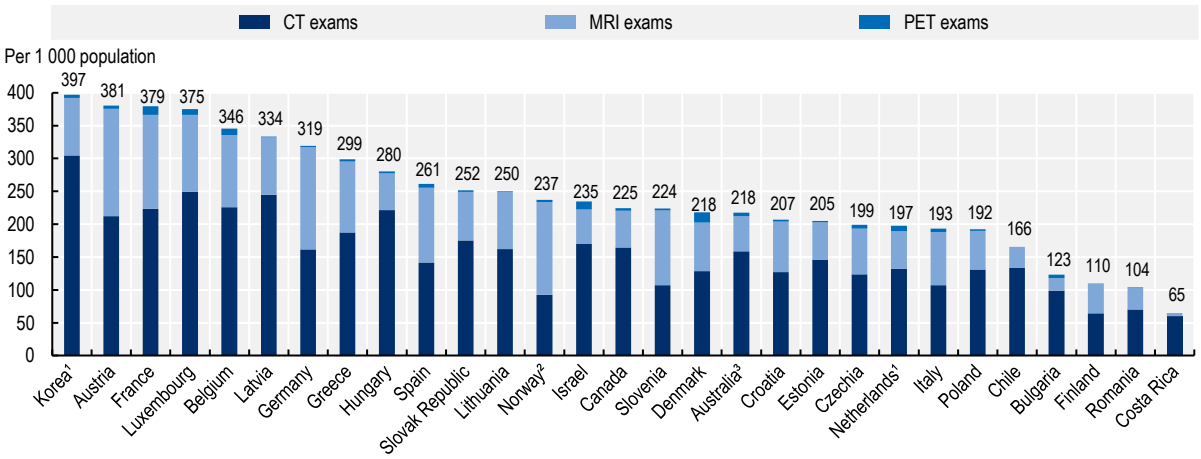
Diagnosis of Attention Deficit Hyperactive Disorder (ADHD) among children increased by 43% in the United States from 2003 to 2011. Some of these likely represent overdiagnosis, stemming from increased recognition of the syndrome, changes in the guidelines for diagnostic criteria, or inappropriate application of the latter by providers (Manos, Giuliano and Geyer, 2017[14]). The resulting follow-up and prescription of unnecessary medication has considerable economic costs, given that healthcare costs of ADHD are estimated at USD 143-266 billion in addition to patient harm caused (Doshi et al., 2012[15]).

Variation in diagnostic processes and use of related procedures is highlighted by data on the use of diagnostic scanners across 26 OECD countries. The combined use of CT, MRI and positron emission tomography (PET) diagnostic scanners is highest in Korea, Austria, France and Luxembourg (Figure 2). Variations persist also at the sub-national level. In Belgium, for example, recent analysis showed a 50% variation in use of diagnostic exams of the spine across provinces in 2017, and this variation was even larger across smaller areas (Devos et al., 2019[16]). In Australia, the age- and sex-adjusted rate of heart perfusion scans varies 50-fold across postcodes (ACSQHC, 2018[17]).

[1] The primary method used for this process is the receiver operating characteristic (ROC) curve.

Increasing use of diagnostic tests and disease-screening raise the risk of false positive results and contribute to overdiagnosis. The number of CT exams almost doubled in Korea, and the number of MRI exams more than doubled in Australia, Korea and Slovenia between 2011 and 2019. Despite the upward trend in the use of diagnostic technologies over time, there were drops across many OECD countries between 2019 and 2020, particularly for MRI exams. Such reductions were due to health providers being forced to delay or cancel diagnostic exams early in the COVID-19 pandemic. In 2021, however, diagnostic exams increased above 2019 levels (OECD, 2023[18]).

## Figure 2. CT, MRI and PET exams, 2022 (or nearest year)




1. Data excludes privately funded exams. 2. Data includes only exams outside hospital. 3. Data excludes exams on public patients (services that do not attract a Medicare benefit,).
Source: OECD Health Statistics 2024, https://www.oecd.org/en/data/datasets/oecd-health-statistics.html.

In addition to imaging, laboratory diagnostics are often also overused. Findings from the Netherlands showed that hospitalised patients had, on average, 5.7 laboratory orders done during the first week of admission[2] and repeat testing of normal test results occurred in up to 85% of patients (Vrijsen et al., 2020[19]). While the costs of laboratory diagnostics are relatively small (less than 5% of hospital spending), they can have significant impacts, as laboratory results influence the majority (between 60-70%) of downstream medical decisions (Shaik et al., 2024[20]). Furthermore, excessive use of laboratory tests can lead to poor outcomes, such as resulting in hospital-induced anaemia, low patient satisfaction (excessive needle pricks, anxiety), and incidental and over diagnosis.

### *Underdiagnosis represents missed opportunity for timely quality care*

As with overdiagnosis, systematic underdiagnosis also has policy implications, reducing the reported global and national health burden of disease where a substantial number of cases are not correctly detected. Research suggests that globally up to 70% of persons with chronic obstructive pulmonary disease (COPD) or asthma do not receive a formal diagnosis of the condition, potentially impacting outcomes and quality of life, and leading to greater healthcare utilisation and poorer work productivity (Aaron et al., 2024[21]). Asthma is a particular challenge as it is both frequently over and under-diagnosed. Findings from the United Kingdom show that asthma overdiagnosis and underdiagnosis among children were potentially as high as 15% and 40% respectively (Lo et al., 2018[7]).

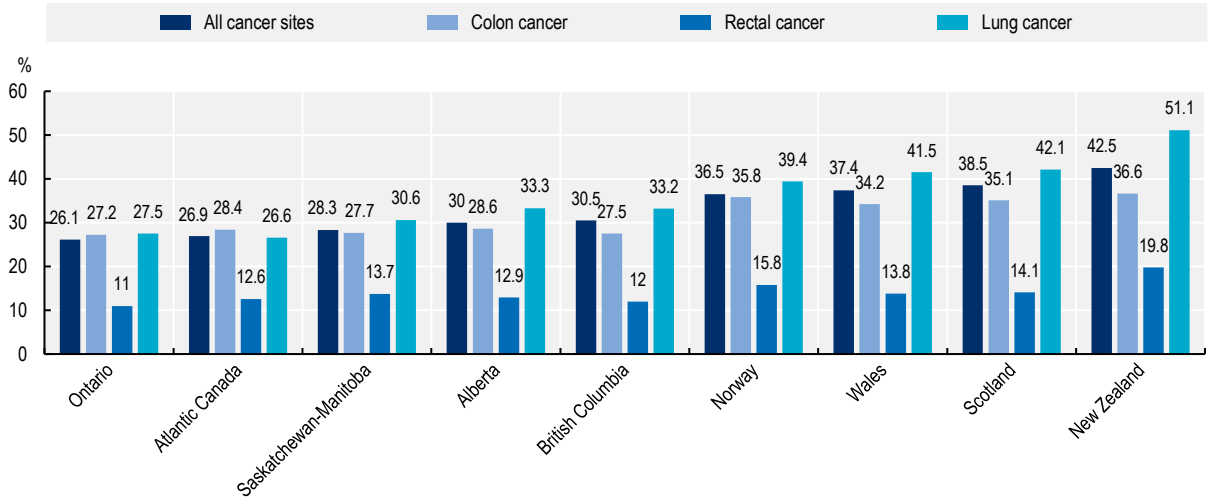
[2] Guidelines advise performing laboratory testing no more than twice per week.

### *Diagnostic error and untimely diagnosis lead to poorer patient outcomes*

Timeliness is an essential component of diagnostic quality and safety, capturing the speed of the communication and use of diagnostic results to patients and healthcare providers and the time needed to establish a correct diagnosis.[3] Delays in diagnostic results can lead to a variety of adverse outcomes such as progression of disease (or spread of communicable diseases), reduced effectiveness of available treatments, and patient anxiety. Misdiagnosis of bipolar disorder as depression in the United States represented higher rates of emergency presentation and hospitalisation for patients, and 45% higher costs than those correctly diagnosed (McIntyre et al., 2022[22]). Likewise, people affected by rare diseases often experience misdiagnosis and diagnostic delays, impacting as many as 90% of patients for some conditions, leading to prolonged suffering and delayed access to potential treatments (Scalco et al., 2017[23]).

Indicators assessing cancer diagnosis resulting from emergency presentations can be used to identify gaps in timely diagnosis by capturing late-stage cancer diagnoses, which often result in poorer patient outcomes (Zhou et al., 2016[24]). Diagnosis following emergency presentation (Figure 3) has been found to be associated with lower survival and worse patient-outcomes as compared to patients with non-emergency diagnoses, even after adjustment for stage at diagnosis (McPhail et al., 2022[25]). In some cases, emergency presentation is not preventable as a result of rapidly advancing disease. However, in other cases such as lung cancer, emergency presentation may reflect disease progression when people are not seeking care through more appropriate channels (e.g. primary care) or a prolonged period following initial symptoms and (mis)diagnosis. The proportion of lung cancer diagnosed at emergency presentation varies widely from 28% in Ontario Canada to 51% in New Zealand, indicating missed opportunity for timely earlier diagnosis. For other cancers, diagnosis should preferably occur as part of organised screening efforts or referred outpatient investigations rather than via emergency presentation. As a result, some emergency presentations are potentially preventable through improved screening and access to diagnostic care, particularly for colorectal and lung cancer (Askari et al., 2017[26]; te Marvelde et al., 2019[27]; Pettit, Al-Hader and Thompson, 2021[28]).

## Figure 3. Percentage of patients diagnosed through emergency presentation by cancer site




Note: Emergency presentation is defined as diagnosis of cancer within 30 days of an emergency hospital admission.
Source: McPhail et al. (2022[25]), "Risk factors and prognostic implications of diagnosis of cancer within 30 days after an emergency hospital admission (emergency presentation): an International Cancer Benchmarking Partnership (ICBP) population-based study", https://doi.org/10.1016/S1470-2045(22)00127-9.

[3] Improving access and the timeliness of presentation to healthcare providers by patients with symptoms is an additional component of timeliness.

## Three lenses for exploring the economic impacts of diagnostic safety

Risk is intrinsic to the process of diagnosis, and harm sometimes occurs even in the best care. The economics of diagnostic safety can be examined through three lenses: the clinical, the behavioural, and the consequences of failure.

### *Clinical indication and interpretation of diagnostic tests and procedures underpin their safe use*

As discussed, diagnostic tools and procedures are never 100% accurate, and can lead to incorrect identification of the presence or absence of a particular condition. The clinical application of screening and diagnostic tests and procedures has the potential to improve outcomes, but also lead to poorer outcomes if the results are inaccurate or not correctly interpretated, communicated in a timely manner, or followed by appropriate care. In addition, many diagnostic tests may be invasive (requiring surgery for example), or expose patients to potential harm (radiation, allergic reactions). Adverse events for more invasive diagnostic procedures, such as liver biopsies, though infrequent, include infection, bleeding, hospitalisation, and even death (Boyum et al., 2016[29]; Thomaides-Brears et al., 2022[30]).

Misdiagnosis may begin with well-intentioned efforts to offer preventive care. General health checks are offered in many health systems with the objectives of detecting disease and managing risk factors, however evidence suggests that they are unlikely to be beneficial for improving health outcomes. Population screening activities may also lead to adverse outcomes and higher costs dependant on the reliability of the tests used. Costs associated with false-positive mammograms and breast cancer overdiagnoses, for example, have been estimated to exceed USD 4 billion annually in the United States (Ong and Mandl, 2015[31]). Moreover, the majority of the commonly used individual screening tests offered have been incompletely validated, and can lead to increased use of diagnostic and therapeutic interventions (Krogsbøll, Jørgensen and Gøtzsche, 2019[32]). For example, COVID-19 antigen tests, when used in people without symptoms, have been found to correctly identify COVID-19 infection only 55% of the time (Cochrane COVID-19 Diagnostic Test Accuracy Group, 2022[33]).

### *Behavioural influences and context add to the complexity of the diagnostic process*

Just as the devices and procedures themselves, the providers that administer and oversee them can be sources of diagnostic error. Healthcare providers can be affected by cognitive biases and personality traits when making diagnosis. In particular, factors such as overconfidence or low risk tolerance, as well as specific cognitive errors including framing, anchoring, availability, search satisficing and premature closure can impact the accuracy of diagnostic outcomes – with such biases associated with inaccuracies in diagnosis for up to 75% of studied scenarios (Saposnik et al., 2016[34]; Lee et al., 2013[35]). Research from the Netherlands concluded that over 80% of the identified diagnostic adverse events found using patient record review were preventable, with the main causes of diagnostic adverse events being human errors related to knowledge-based mistakes and information transfer problems (Zwaan et al., 2010[36]).

Historically, diagnostic errors have been thought of as individual failures – resulting from the shortcomings of individual healthcare providers who misjudge or lack the needed knowledge. While this is still the case in instances, diagnostic errors are also the result of systemic shortcomings in the organisation and incentives for care delivery, resulting in unfavourable conditions for accurate or timely diagnostic care. A survey of primary care doctors in England found that system factors, such as poor communication between primary and secondary care, was the most cited reason for the occurrence of diagnostic delays (Car et al., 2016[37]). Variation in diagnostic practice is also firmly entwined with inequity and the inverse care law.[4] An

[4] Inverse care law i.e. those who most need medical care are least likely to receive it. Conversely, those with least need of healthcare tend to use health services more and more effectively.

Australian study of geographic variation in angiography rates found no correlation with cardiac disease burden. Instead, angiography was strongly correlated with private hospital admission (Chew et al., 2016[38]).

### *The burden of diagnostic safety failure is underestimated and likely substantial to economies.*

Estimating the direct financial consequences of wrong or delayed diagnosis is fundamentally different than for other types of safety failures that result in harms such as nosocomial infections or pressure injuries. The latter are outcomes. It is therefore a case of calculating the resulting clinical management and care.

Failure in diagnostic safety, meanwhile, is more remote to desired outcomes. It can precipitate a variety of consequences that largely depend on the type of failure. ***Misdiagnosis*** incurs additional costs, firstly, by taking the patient down an incorrect treatment path, administering therapies that are unnecessary and thus wasteful, that may in themselves predispose the patient to iatrogenic harm, and that will need to be eventually rectified once the correct diagnosis is (hopefully) made. In the likely event that the disease has progressed, the eventual correct treatment is likely to be of higher intensity and cost than had the correct diagnosis been made initially. ***Delayed diagnosis*** plays out in a similar fashion, supplanting simpler treatment – in many cases secondary prevention – with therapies that are more onerous, invasive and costly. Quantifying the additional cost in both scenarios is difficult. It requires labour-intensive methods as well as speculation and assumptions about the counterfactual because, *inter alia,* a comparison cohort of similar patients who did not experience that specific diagnostic safety failure with those specific pathological and clinical consequences is not easily identified (unlike, for example, a patient who develops venous thromboembolism following hip arthroplasty). Medicolegal costs should also be included in the direct costs given diagnostic error is, by a considerable margin, the leading cause of malpractice claims in some jurisdictions (Graber, 2013[39]). ***Overdiagnosis****,* meanwhile, sets in motion a costly and risk-laden treatment path that may, in some cases, be completely unnecessary. For example, imaging of uncomplicated low back pain not only uses scarce healthcare resources, it can generate an incidental diagnosis that is unrelated to the patient's symptoms yet create a cascade of referral and inappropriate (sometimes invasive) interventions that come with a high cost but little benefit (Sajid, Parkunan and Frost, 2021[40]).

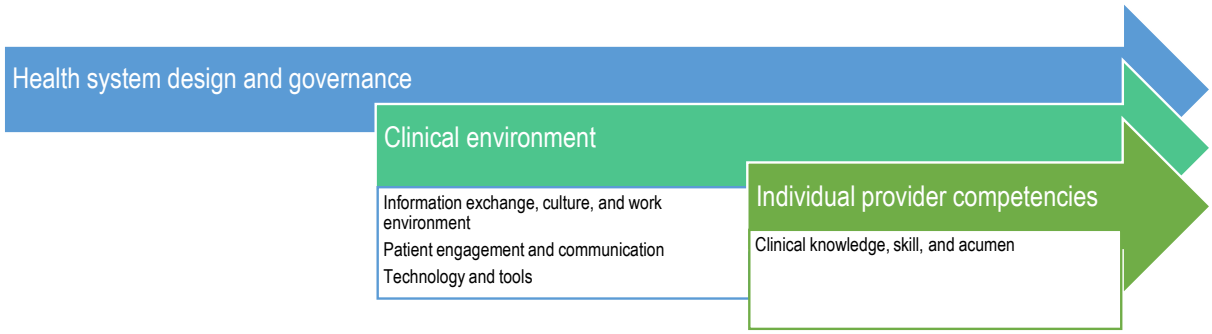
Diagnostic safety failures are common and harmful. A study published in 2023 focusing on *misdiagnosis* of major diseases across clinical settings that included ambulatory clinics, emergency department and inpatients estimated that 2.59 million diagnostic errors occur in the United States each year, resulting in approximately 371 000 deaths and 424 000 permanently disabled due to misdiagnosis each year, making it the single largest source of serious harms from safety failures (Newman-Toker et al., 2024[41]). In addition, the incidence of diagnostic harm may be underestimated. A prospective United States study using unannounced standardised patient visits[5] found that the true costs of diagnostic error during internal medicine consultations were 20 times higher than would be discerned by retrospective record review (Schwartz et al., 2012[42]). A picture emerges that diagnostic safety failures cause much harm, perhaps as much as other "downstream" types of harm (adverse events) combined. Given that approximately 12% of healthcare expenditure is consumed by managing the latter, the above findings suggest that the combined resource cost of diagnostic safety failure could equal that amount again (assuming that adverse events are independent of diagnostic errors that may have preceded them). This is arguably a conservative estimate given the occult nature diagnostic safety failure, and the evidence that traditional methods underestimate the extent of its consequences.

[5] Unannounced Standardised Patients (USPs) are individuals trained to act as real patients in a consistent and standardised manner, but they do so without informing the healthcare providers that they are part of an assessment or training exercise.

## Diagnostic outcomes can be improved via interventions targeting the health system, clinical environment, and individual providers

There are numerous levers that can improve diagnostic safety outcomes. Deficits in these areas can drive poor diagnostic outcomes, while improvements can influence better diagnostic performance. These variables are visualised in Figure 4 and described in further detail below.

### Figure 4. Sources and drivers of diagnostic outcomes




- **Health system design and governance:** Standards and systems to support healthcare workforce can improve diagnostic outcomes by assuring the quality of care, processes, and procedures. Healthcare systems can undertake efforts to promote organisational cultures conducive to diagnostic safety, invest and utilise data for measurement and analysis, and create leadership incentives for supporting institutional capacity for improving diagnostic safety.
- **Information exchange, culture and work environment:** Good communication and information exchange ensures that required information is available and used in the diagnostic process. Teamwork, openness, and effective patient referral pathways and transitions – components of patient safety culture – are essential for ensuring this.
- **Patient engagement and communication:** Providers need to be able to explain complex health diagnoses and treatment approaches to patients in a user-friendly, easily understood manner. In addition, patient autonomy can play a role in detecting and preventing diagnostic safety errors – for example by identifying inaccurate documentation or information gaps.
- **Technology and tools:** Electronic health records (EHR) and other digital technology can contribute to reducing diagnostic harm. Accurate and accessible EHR data is needed to track diagnostic outcomes, ensure appropriate follow-up of results, and prevent the unnecessary duplication of tests. Novel diagnostic tests and AI support tools need to be properly assessed to ensure that overdiagnosis is not an unintended consequence.
- **Clinical knowledge, skill and acumen:** The safety of the diagnostic process heavily depends on individual clinicians, in particular, the awareness, and management of, cognitive and behavioural processes that can lead to incorrect diagnosis. Providing feedback to physicians can help standardise or optimise to acceptable norms the ordering of diagnostic tests. For example, in Australia, the National Prescribing Service's feedback to GPs on their rates of referrals for CT scans for low back pain was associated with an 11% fall in referral rate, equivalent to some 50 000 scans (OECD, 2017[43]).

The OECD is currently undertaking work to further assess key drivers and barriers of diagnostic safety and estimate the economic impacts of poor diagnostic safety practices on health systems. It will examine available data, metrics and benchmarks that can be used to quantify and analyse the scope of the challenge. A report is expected to be published in 2025.

## References


Aaron, S. et al. (2024), "Early Diagnosis and Treatment of COPD and Asthma — A Randomized, Controlled Trial", *New England Journal of Medicine*, Vol. 390/22, pp. 2061-2073, https://doi.org/10.1056/NEJMOA2401389. [21]

ACSQHC (2018), *Third Australian Atlas of Healthcare Variation: Myocardial perfusion scans, 18 years and over | Australian Commission on Safety and Quality in Health Care*, https://www.safetyandquality.gov.au/our-work/healthcare-variation/third-atlas-2018/atlas-2018-4-cardiac-tests/43-myocardial-perfusion-scans-18-years-and-over (accessed on 24 July 2024). [17]

Angus, D. et al. (2016), "A Framework for the Development and Interpretation of Different Sepsis Definitions and Clinical Criteria", *Critical care medicine*, Vol. 44/3, p. e113, https://doi.org/10.1097/CCM.0000000000001730. [5]

Askari, A. et al. (2017), "Who requires emergency surgery for colorectal cancer and can national screening programmes reduce this need?", *International Journal of Surgery*, Vol. 42, pp. 60-68, https://doi.org/10.1016/J.IJSU.2017.04.050. [26]

Auraaen, A., L. Slawomirski and N. Klazinga (2018), "The economics of patient safety in primary and ambulatory care: Flying blind", *OECD Health Working Papers*, No. 106, OECD Publishing, Paris, https://doi.org/10.1787/baf425ad-en. [2]

Balogh, E. et al. (2015), "Improving Diagnosis in Health Care", *Improving Diagnosis in Health Care*, pp. 1-472, https://doi.org/10.17226/21794. [1]

Ben-Assuli, O. et al. (2019), "The use of analytic hierarchy process for measuring the complexity of medical diagnosis", *Health Informatics Journal*, Vol. 26/1, pp. 218-232, https://doi.org/10.1177/1460458218824708. [4]

Boyum, J. et al. (2016), "Incidence and Risk Factors for Adverse Events Related to Image-Guided Liver Biopsy", *Mayo Clinic Proceedings*, Vol. 91/3, pp. 329-335, https://doi.org/10.1016/J.MAYOCP.2015.11.015. [29]

Braithwaite, J., R. Wears and E. Hollnagel (2015), "Resilient health care: turning patient safety on its head", *International Journal for Quality in Health Care*, Vol. 27/5, pp. 418-420, https://doi.org/10.1093/intqhc/mzv063. [11]

Car, L. et al. (2016), "Clinician-identified problems and solutions for delayed diagnosis in primary care: a PRIORITIZE study", *BMC Family Practice*, Vol. 17/1, https://doi.org/10.1186/S12875-016-0530-Z. [37]

Chew, D. et al. (2016), "Variation in coronary angiography rates in Australia: correlations with socio-demographic, health service and disease burden indices", *The Medical Journal of Australia*, Vol. 205/3, pp. 114-120, https://doi.org/10.5694/MJA15.01410. [38]

Cochrane COVID-19 Diagnostic Test Accuracy Group (2022), "Rapid, point-of-care antigen tests for diagnosis of SARS-CoV-2 infection", *Cochrane Database of Systematic Reviews*, Vol. 2022/7, https://doi.org/10.1002/14651858.cd013705.pub3. [33]

Devos, C. et al. (2019), “Performance of the Belgian health system – report 2019 – Supplement: technical sheets for indicators”, https://www.pasderayonssansraisons.be/ihttps://www.health.belgium.be/en/node/27827 (accessed on 8 July 2024). [16]

Doshi, J. et al. (2012), “Economic Impact of Childhood and Adult Attention-Deficit/Hyperactivity Disorder in the United States”, *Journal of the American Academy of Child & Adolescent Psychiatry*, Vol. 51/10, pp. 990-1002.e2, https://doi.org/10.1016/j.jaac.2012.07.008. [15]

Enck, P. et al. (2016), “Irritable bowel syndrome”, *Nature Reviews Disease Primers 2016 2:1*, Vol. 2/1, pp. 1-24, https://doi.org/10.1038/nrdp.2016.14. [6]

Espinosa Gonzalez, A. and E. Suzuki (2024), “The impacts of long COVID across OECD countries”, *OECD Health Working Papers*, No. 167, OECD Publishing, Paris, https://doi.org/10.1787/8bd08383-en. [10]

Graber, M. (2013), “The incidence of diagnostic error in medicine”, *BMJ Quality & Safety*, Vol. 22/Suppl 2, pp. ii21-ii27, https://doi.org/10.1136/BMJQS-2012-001615. [39]

Hollnagel, E., R. Wears and J. Braithwaite (2015), *From Safety-I to Safety-II: A White Paper*, National Library of Congress. [12]

Krogsbøll, L., K. Jørgensen and P. Gøtzsche (2019), “General health checks in adults for reducing morbidity and mortality from disease”, *The Cochrane Database of Systematic Reviews*, Vol. 2019/1, https://doi.org/10.1002/14651858.CD009009.PUB3. [32]

Lee, C. et al. (2013), “Cognitive and System Factors Contributing to Diagnostic Errors in Radiology”, *American Journal of Roentgenology*, Vol. 201/3, pp. 611-617, https://doi.org/10.2214/ajr.12.10375. [35]

Li, C. et al. (2020), “Mining Misdiagnosis Patterns from Biomedical Literature”, *AMIA Summits on Translational Science Proceedings*, Vol. 2020, p. 360, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7233073/. [8]

Lo, D. et al. (2018), “Misdiagnosis of children’s asthma is common in UK primary care and can be improved with objective tests”, *European Respiratory Journal*, Vol. 52/suppl 62, p. PA1314, https://doi.org/10.1183/13993003.CONGRESS-2018.PA1314. [7]

Manos, M., K. Giuliano and E. Geyer (2017), “ADHD: Overdiagnosed and overtreated, or misdiagnosed and mistreated?”, *Cleveland Clinic Journal of Medicine*, Vol. 84/11, pp. 873-880, https://doi.org/10.3949/ccjm.84a.15051. [14]

McIntyre, R. et al. (2022), “The real-world health resource use and costs of misdiagnosing bipolar I disorder”, *Journal of Affective Disorders*, Vol. 316, pp. 26-33, https://doi.org/10.1016/j.jad.2022.07.069. [22]

McPhail, S. et al. (2022), “Risk factors and prognostic implications of diagnosis of cancer within 30 days after an emergency hospital admission (emergency presentation): an International Cancer Benchmarking Partnership (ICBP) population-based study”, *The Lancet Oncology*, Vol. 23/5, pp. 587-600, https://doi.org/10.1016/S1470-2045(22)00127-9. [25]

Müskens, J. et al. (2022), “Overuse of diagnostic testing in healthcare: a systematic review”, *BMJ Quality & Safety*, Vol. 31/1, p. 54, https://doi.org/10.1136/BMJQS-2020-012576. [13]

Newman-Toker, D. et al. (2024), "Burden of serious harms from diagnostic error in the USA", *BMJ Qual Saf*, Vol. 33, pp. 109-120, https://doi.org/10.1136/bmjqs-2021-014130. [41]

OECD (2023), *Health at a Glance 2023: OECD Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/7a7afb35-en. [18]

OECD (2017), *Tackling Wasteful Spending on Health*, OECD Publishing, Paris, https://doi.org/10.1787/9789264266414-en. [43]

Ong, M. and K. Mandl (2015), "National Expenditure For False-Positive Mammograms And Breast Cancer Overdiagnoses Estimated At $4 Billion A Year", *Health Affairs*, Vol. 34/4, pp. 576-583, https://doi.org/10.1377/hlthaff.2014.1087. [31]

Pettit, N., A. Al-Hader and C. Thompson (2021), "Emergency department associated lung cancer diagnosis: Case series demonstrating poor outcomes and opportunities to improve cancer care", *Current Problems in Cancer: Case Reports*, Vol. 3, p. 100059, https://doi.org/10.1016/J.CPCCR.2021.100059. [28]

Polaris (2023), "Self-Testing Market Size, Growth Demand, Forecast, 2032", https://www.polarismarketresearch.com/industry-analysis/self-testing-market (accessed on 30 July 2024). [9]

Sajid, I., A. Parkunan and K. Frost (2021), "Unintended consequences: quantifying the benefits, iatrogenic harms and downstream cascade costs of musculoskeletal MRI in UK primary care", *BMJ open quality*, Vol. 10/3, https://doi.org/10.1136/BMJOQ-2020-001287. [40]

Saposnik, G. et al. (2016), "Cognitive biases associated with medical decisions: a systematic review", *BMC Medical Informatics and Decision Making*, Vol. 16/1, pp. 1-14, https://doi.org/10.1186/S12911-016-0377-1. [34]

Scalco, R. et al. (2017), "Misdiagnosis is an important factor for diagnostic delay in McArdle disease", *Neuromuscular Disorders*, Vol. 27/9, pp. 852-855, https://doi.org/10.1016/j.nmd.2017.04.013. [23]

Schwartz, A. et al. (2012), "Uncharted territory: Measuring costs of diagnostic errors outside the medical record", *BMJ Quality and Safety*, Vol. 21/11, pp. 918-924, https://doi.org/10.1136/BMJQS-2012-000832. [42]

Shaik, T. et al. (2024), "Lab testing overload: a comprehensive analysis of overutilization in hospital-based settings", *Proceedings (Baylor University. Medical Center)*, Vol. 37/2, p. 312, https://doi.org/10.1080/08998280.2023.2288788. [20]

Slawomirski, L. and N. Klazinga (2022), "The economics of patient safety: From analysis to action", *OECD Health Working Papers*, No. 145, OECD Publishing, Paris, https://doi.org/10.1787/761f2da8-en. [3]

te Marvelde, L. et al. (2019), "Alignment with Indices of A Care Pathway Is Associated with Improved Survival: An Observational Population-based Study in Colon Cancer Patients", *EClinicalMedicine*, Vol. 15, pp. 42-50, https://doi.org/10.1016/j.eclinm.2019.08.009. [27]

Thomaides-Brears, H. et al. (2022), "Incidence of Complications from Percutaneous Biopsy in Chronic Liver Disease: A Systematic Review and Meta-Analysis", *Digestive Diseases and Sciences*, Vol. 67/7, pp. 3366-3394, https://doi.org/10.1007/S10620-021-07089-W/TABLES/4. [30]

Vrijsen, B. et al. (2020), "Inappropriate laboratory testing in internal medicine inpatients: Prevalence, causes and interventions", *Annals of Medicine and Surgery*, Vol. 51, p. 48, https://doi.org/10.1016/J.AMSU.2020.02.002. [19]

Zhou, Y. et al. (2016), "Diagnosis of cancer as an emergency: a critical review of current evidence", *Nature Reviews Clinical Oncology 2016 14:1*, Vol. 14/1, pp. 45-56, https://doi.org/10.1038/nrclinonc.2016.155. [24]

Zwaan, L. et al. (2010), "Patient record review of the incidence, consequences, and causes of diagnostic adverse events", *Archives of internal medicine*, Vol. 170/12, pp. 1015-1021, https://doi.org/10.1001/ARCHINTERNMED.2010.146. [36]

## Contact

Katherine DE BIENASSIS (✉ katherine.debienassis@oecd.org)

David KELLY (✉ david.kelly@oecd.org)

This brief has been authored by Katherine de Bienassis, Luke Slawomirski, David Kelly, and Niek Klazinga.