An illustration of a human kidney in shades of yellow and orange, set against a teal background. A hand in a white lab coat with an orange cuff is holding a magnifying glass over the kidney. The magnifying glass shows a close-up of the kidney's internal structure, with blue wavy lines representing the renal cortex. The overall style is clean and modern.

**ECONOMIST
IMPACT**

Chronic kidney disease

Driving change to address the urgent and silent epidemic in Europe

Supported by

AstraZeneca 

Contents

- 3** About this report
- 5** Executive summary
- 8** Chapter 1. A primer on CKD
- 11** Chapter 2. Prevalence and impact in Europe: a steep rise
- 14** Chapter 3. Levers to address the CKD epidemic
- 20** Policy recommendations
- 23** References

About this report

The prevalence of chronic kidney disease (CKD)—the progressive decline of kidney function—is on the rise globally, and Europe is no exception. Prevalence is outpacing other, more recognised, non-communicable diseases and is creating a significant and growing socioeconomic burden. Yet, it is under-recognised by many stakeholders who could inspire impactful change.

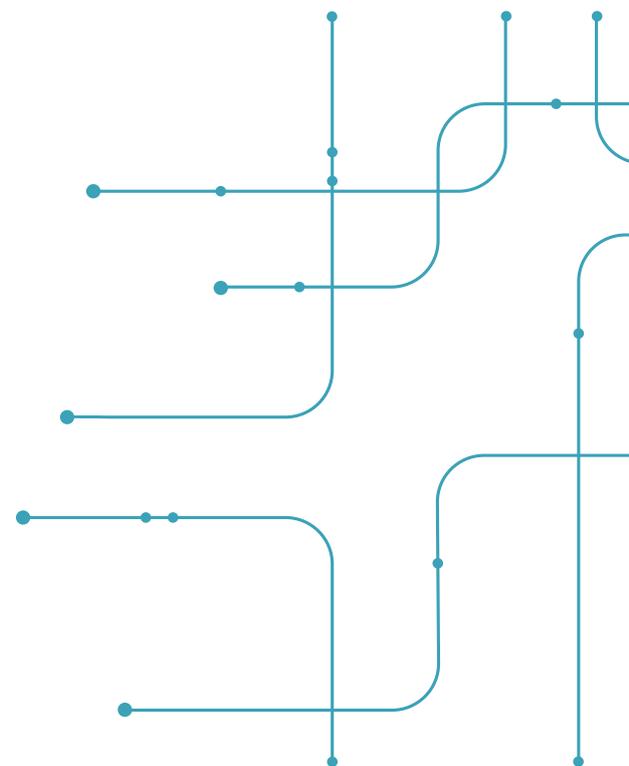
This white paper is one of the deliverables in a broader project, designed and conducted by Economist Impact, which was funded and initiated by AstraZeneca. It presents the findings of in-depth research to understand the impact of CKD across Europe and identify solutions, such as targeted policy change, that have the potential to alleviate the growing financial and disease burden of CKD.

Our research started with a literature review. Economist Impact then convened an expert panel to discuss the challenges and successes related to early CKD detection. Finally, we spoke with stakeholders in Europe, representing advocates, providers, researchers and academics.

We would like to thank everyone who participated for their time and insights:

Advisory board

- **Andrzej Fal**, professor and chair, Department of Organization and Economics of the Health System, National Institute of Public Health, Poland
- **Jaime Espin**, professor, Andalusian School of Public Health, Spain
- **Loreto Gesualdo**, head, Nephrology, Dialysis and Transplantation Unit, Università degli Studi di Bari Aldo Moro, Italy
- **Raymond Vanholder**, president, European Kidney Health Alliance, Belgium

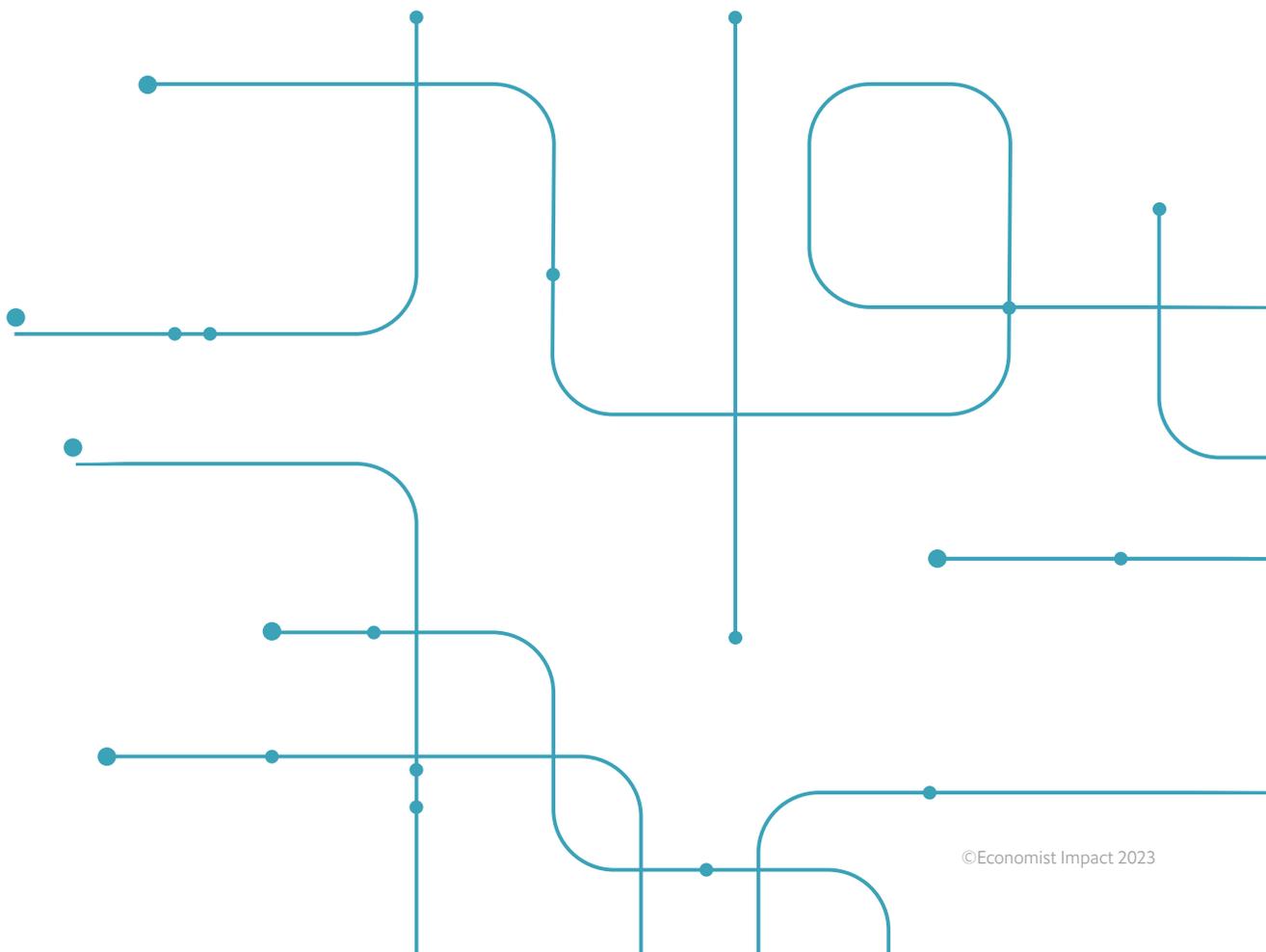


Interviews

- **Adrian Covic**, professor, Internal Medicine and Nephrology, Universitatea de Medicină și Farmacie Grigore T. Popa, Romania
- **Edgar de Almeida**, professor of nephrology, University of Lisbon, Portugal
- **Isabelle Tostivint**, nephrologist, Nephrology Department, Pitié Salpêtrière, France
- **George Stergiou**, professor of medicine and hypertension, University of Athens, Greece
- **Luca de Nicola**, full professor of nephrology, University Vanvitelli Naples, Italy
- **María José Soler**, chief of clinical nephrology and dialysis, Hospital Universitari Vall d'Hebron, Spain
- **Marja Ho-Dac**, director, Dutch Kidney Patient Association, the Netherlands
- **Martin Koczor**, vice-president, Bundesverband Niere e.V. kennen, Germany
- **Michel Jadoul**, head of nephrology department, Saint-Luc University Clinics, Catholic University of Louvain, Belgium
- **Ryszard Gellert**, director, Medical Center of Postgraduate Education, Poland

The research and literature review were undertaken by Aanisah Khanzada and Giulia Garcia. The report was written by contributing writer Rebecca Lipman. Rob Cook and Elly Vaughan oversaw the research programme. The findings and views expressed in this briefing paper are those of Economist Impact and do not necessarily reflect the sponsor's or interviewees' views.

March 2023



Executive summary

CKD affects about one in ten adults across Europe.¹ An estimated 100 million people in Europe are living with this long-term, progressive disease and a further 300 million individuals are at risk.^{2,3} CKD claims millions of lives prematurely each year and costs European healthcare systems around €140bn.^{2,4}

The challenge is that few people know they have the disease because its early stages are usually asymptomatic.⁵ Several nephrology professionals therefore recommended CKD screening for at-risk asymptomatic individuals, with the goal being identifying and managing CKD as well as preventing the disease's progression along with its associated cardiovascular disease risk.

Current health interventions for advanced CKD focus on specialist treatments (such as dialysis and kidney transplants), which are expensive and invasive. If detected early and countered with preventive care and therapeutic interventions, its progression can be slowed and complications minimised, helping people live longer, healthier lives. Healthier lives reduce the socioeconomic impact of CKD.⁶⁻⁸

Early detection of CKD should be a priority and an essential component of government health plans and public health programmes across Europe. This report investigates why it is not and how Europe's approach to CKD can be improved.

We undertook a comprehensive literature review, expert interviews and an expert panel to assess the availability, accessibility and quality of CKD early detection efforts,

screening programmes and related policies in ten European countries. The research also explored patients' perceptions of CKD and the costs to health systems and economies. It offers top level policy takeaways and actions that could help to mitigate this disease's impact across Europe.

Key findings:

CKD awareness is lacking. About 100 million people are estimated to have CKD in Europe.² Despite this, awareness of CKD remains low among the general public and primary care physicians. Improved awareness is important, as it could drive earlier and more frequent testing, adherence to health interventions and risk-reducing lifestyle changes.^{9,10}

As CKD progresses, it becomes more costly and burdensome for patients and healthcare systems. CKD is a progressive disease, with five stages, that affects all bodily systems. Most patients are asymptomatic in the early stages and begin to develop non-specific symptoms such as tiredness. As a result, diagnosis is often delayed. People receiving renal replacement therapy, such as dialysis or a transplant, experience further losses in quality of life. Treatments in this stage are expensive for healthcare systems.¹¹⁻¹⁵

Early CKD detection is not a priority in much of Europe. Detecting CKD early allows timely treatment, which reduces the rates of more serious disease.^{13,15} Timely lifestyle changes and healthcare interventions for CKD and comorbidities

can slow progression of the disease.^{6,8} Our research found that few countries in Europe have introduced early detection programmes, even among at-risk populations.¹³

A large cross-section of people with CKD has comorbidities. Owing to the vital role that kidneys play, CKD is closely comorbid with other conditions, such as hypertension, diabetes and heart disease.¹⁶⁻¹⁸ Many comorbidities are risk factors as well as outcomes, and the interplay between them hastens health decline. Comorbidities increase the complication of healthcare as well as the costs to healthcare systems.¹⁶⁻¹⁸

Renal registries typically focus on the later stages of CKD. At present, most renal registries across Europe focus on the stages of the disease when monitoring and outcome measurements are particularly important.¹⁹ A few countries are expanding the scope of these to include earlier stages.¹⁹ Inconsistency in how data are captured and the challenges with comparing data between registries are some of the challenges to robust analysis.

Clinical guidelines for CKD are often not followed or implemented at a national level. Clinical guidelines can drive change and provide consistent advice to close gaps in practice. Yet we found many countries in Europe do not have national CKD guidelines. Health professionals need localisation of guidance, including tools and referral pathways, for implementation. Integrated care arrangements, which consider the specific health system characteristics and contexts within countries, were being considered in some countries but not yet widely or fully developed.

Key policy takeaways

Increase education and awareness. First, public awareness could be increased through population-wide campaigns. Second, awareness and knowledge of CKD among the primary healthcare workforce could be increased via clinical education programmes. Third, patient advocacy groups can be supported to communicate more widely with clear messaging around the issue. Fourth, policymakers can add balance to existing national health policies so that CKD awareness and education is prioritised by multiple stakeholders.

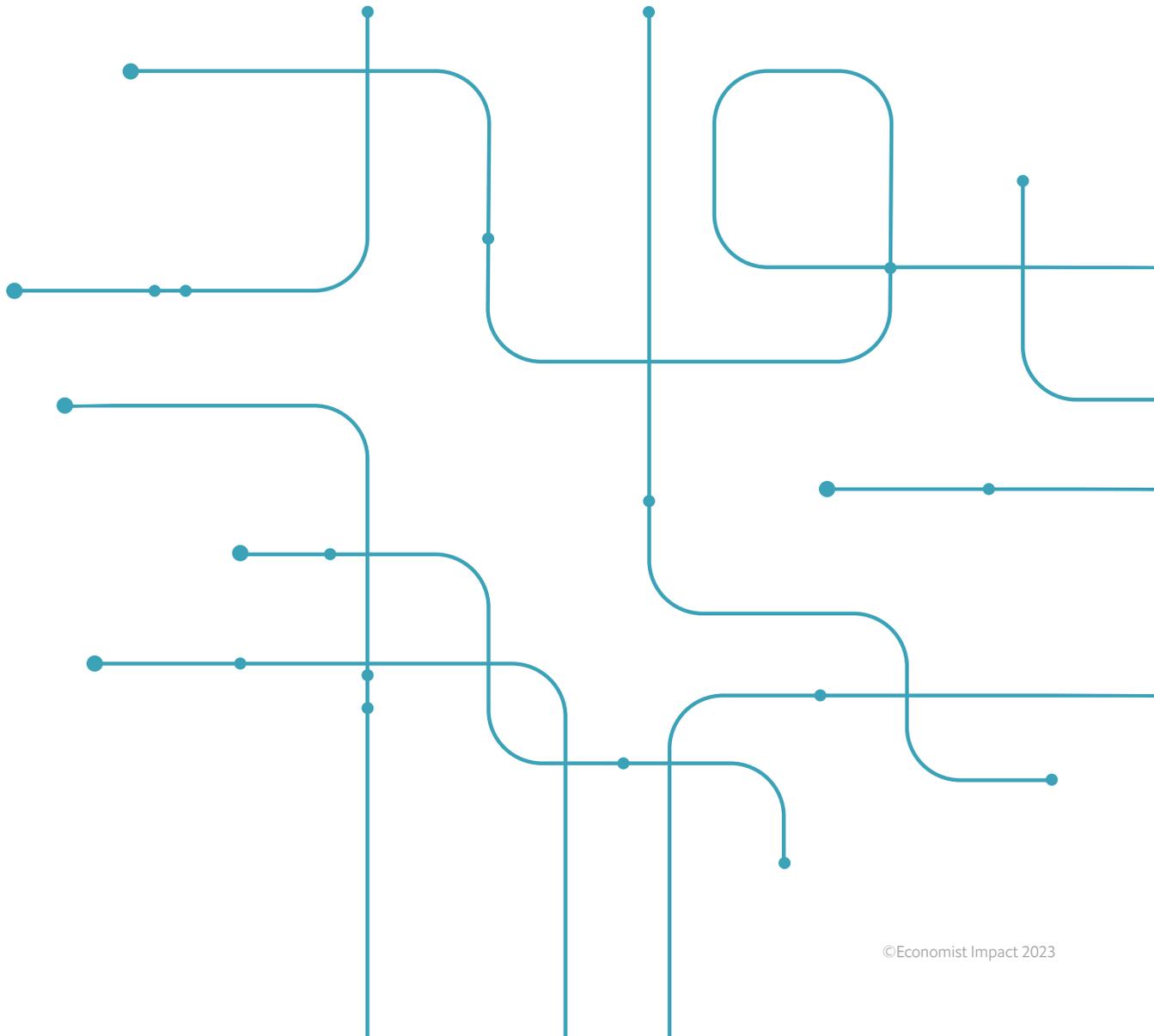
Implement targeted screening for at-risk individuals. Early detection and monitoring strategies for at-risk populations should be introduced. In addition to this, CKD testing could be integrated into health checks in countries that have these. Incentives could also encourage testing of at-risk patients.

Integrate CKD management strategies into those of other non-communicable diseases (NCDs). When trying to reduce the burden of CKD, it should not be isolated from other NCDs, especially since CKD is commonly comorbid with heart disease, diabetes and hypertension. Policymakers should look to address CKD both separately and alongside heart disease and diabetes strategies.

Expand renal registries to include the earlier stages of CKD. This will foster better understanding of the epidemiology of the disease and outcomes. It will provide countries with data on how many individuals are in the early stages of CKD and monitor the results of disease management programmes.

Adapt international guidelines for national use. The Kidney Disease Improving Global Outcomes (KDIGO) is a global organisation that develops evidence-based clinical practice guidelines. These guidelines are well respected globally and should be locally tailored for both patients and clinicians. Targeted and simplified tools could be developed from guidelines and aimed at primary care providers. Teaching of guideline-based care could be included in medical school curriculums.¹⁵

Foster the development of digital solutions. Countries should continue to invest in electronic health records and develop long-term plans for maximising the data collected by renal registries. Standards are required for the exchange of data, for example, ensuring better structuring of data for interoperability and ensuring timely, complete data reporting.



Chapter 1. A primer on CKD

CKD: a progressive and underdiagnosed disease

Kidneys are the body’s filtration system, responsible for removing waste, toxins and excess fluids from the blood. When kidney function declines, excess fluid and waste can trigger a spectrum of other health problems, including heart disease and stroke.^{21,22}

What do kidneys do?²¹⁻²³

- Filter all of the body’s blood every 30 minutes
- Help to control blood pressure
- Stimulate red blood cell production
- Keep bones healthy
- Regulate blood chemicals
- Secrete essential hormones

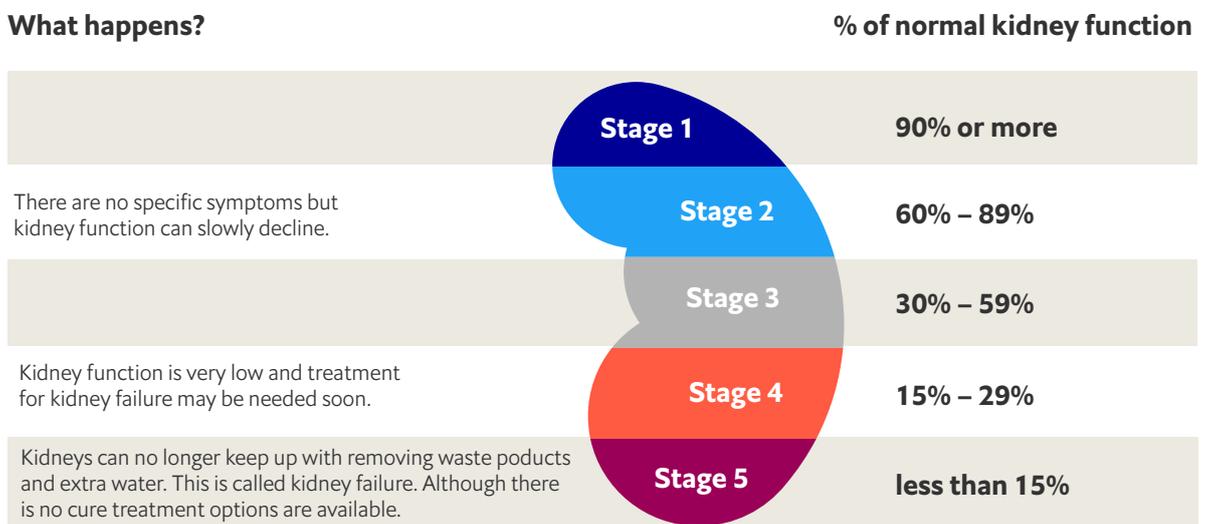
Defining CKD^{21, 24}

CKD is defined as abnormalities of either the kidney structure or its function that are present for more than three months and have health implications.

While it is possible to have acute kidney problems, CKD is an incurable, long-term condition in which kidney function (also called renal function) declines with time.²¹

CKD is broken into five stages, each of which is associated with progressive damage.²⁵ Early-stage symptoms (stage 1-3) are often absent or nonspecific, and include muscle cramps, fatigue, nausea, and changes to sleep, appetite and urination. Kidney functionality is reduced by around half in stage 3.^{26, 27}

Figure 1: The five stages of CKD²⁶



Source: World Kidney Day and American Kidney Fund.^{26, 27}

By stage 4, kidney function is severely impacted. Stage 5 (also known as end-stage kidney disease, when there is less than 15% functionality) is eventually fatal without treatment, which includes artificial filtering (dialysis—a renal replacement therapy that replaces the normal blood-filtering function of the kidneys) or a kidney transplant.²⁶

Dialysis is largely broken down into two forms: haemodialysis and peritoneal dialysis. Haemodialysis requires the patient to use an artificial kidney machine.²⁸ This is a 3-5 hour process that can take place in a hospital or dialysis centre three times a week.^{28, 29} Peritoneal dialysis uses the lining of the abdomen as a filter and can be carried out at home on a daily basis through a catheter permanently inserted in the abdomen.³⁰

Up to 82% of individuals living with stage 3 CKD are undiagnosed.³¹ Research suggests that half of the affected individuals remain undiagnosed even at stages 4 and 5, when symptoms start to show.³¹ Most people with CKD will die of related problems—mainly heart disease—before they reach stage 5.^{11, 12, 14}

Progression between stages varies and is unpredictable.³² In some, progression happens in months, while for others it takes years.³³

CKD comorbidities

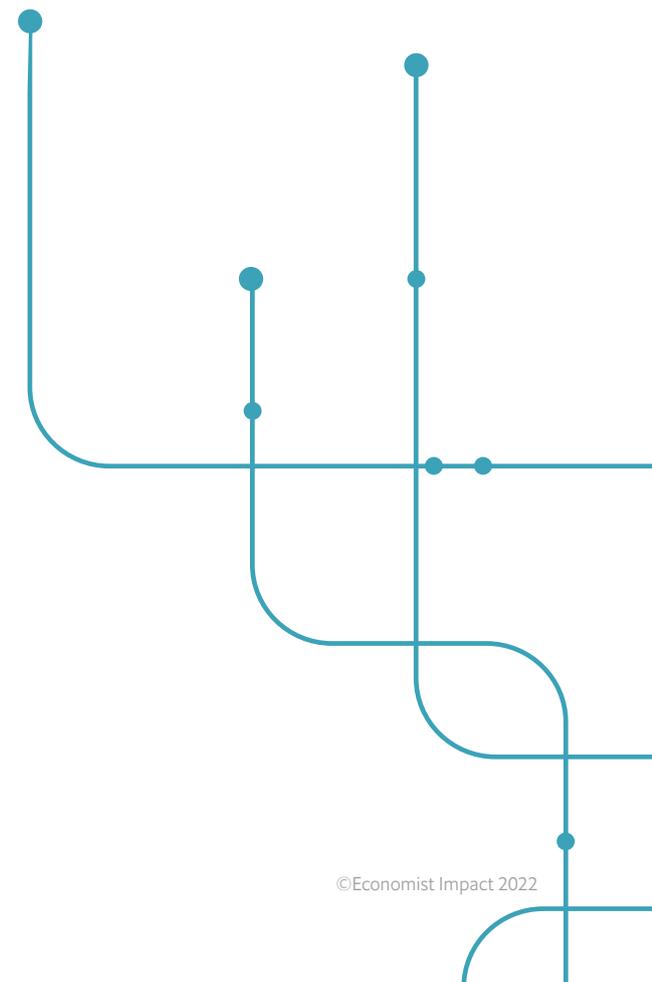
CKD is closely comorbid with other conditions.^{16-18, 34} CKD comorbidity is particularly strong with chronic heart disease (present in about 35% of CKD patients), hypertension (present in about 80% of CKD patients) and diabetes (present in around 26% of CKD patients).³⁵⁻³⁷

The presence of comorbidities alongside CKD can accelerate kidney and general health decline.³⁸ For example, heart disease increases the progression of kidney damage, and low kidney function worsens heart disease, making heart failure more likely.³⁹⁻⁴¹

“When I see a patient with CKD, I know that she/he has 50% chance of dying from cardiovascular disease before reaching the stage of end-stage kidney disease requiring dialysis or transplantation” says George Stergiou, professor of Medicine & Hypertension at the University of Athens in Greece.

“Having a label of CKD is the single most powerful predictor of a worse outcome for any disease,” says Adrian Covic, professor of Internal Medicine & Nephrology at the Universitatea de Medicină și Farmacie Grigore T. Popa Iasi in Romania.

People living with CKD have also had their health significantly impacted by COVID-19.⁴² Various systematic reviews showed an increased risk of hospitalisations, increased risk of severe infections and a higher risk of death with COVID-19 among those with CKD compared with those who did not have CKD.⁴²



Who is at risk?

People with diabetes and hypertension are at increased risk of CKD.³⁹⁻⁴¹ In the case of diabetes, high levels of extra glucose in the blood damages the kidney's blood vessels and degrades function over time.⁴³ Hypertension can damage the kidney's blood vessels, impacting its performance.⁴⁴

Some CKD risk factors are modifiable. For example, smoking, obesity, poor diet, environmental exposures, and damage from toxic drugs or poisons can often be addressed through primary care and lifestyle changes.⁴⁵

Others, such as old age, gender, abnormal kidney structure, past kidney damage, heart disease, genetics or a family history of kidney disease, and certain infections and diseases, are out of an individual's control.^{35, 46} Certain ethnic populations, specifically Black and Asian groups, are up to five times more likely to develop CKD than other populations.⁴⁷ Those at a higher risk of CKD should be a target of screening at primary care practices.²

Disease detection

The impact of CKD on patients and families can be severe. However, if caught early,

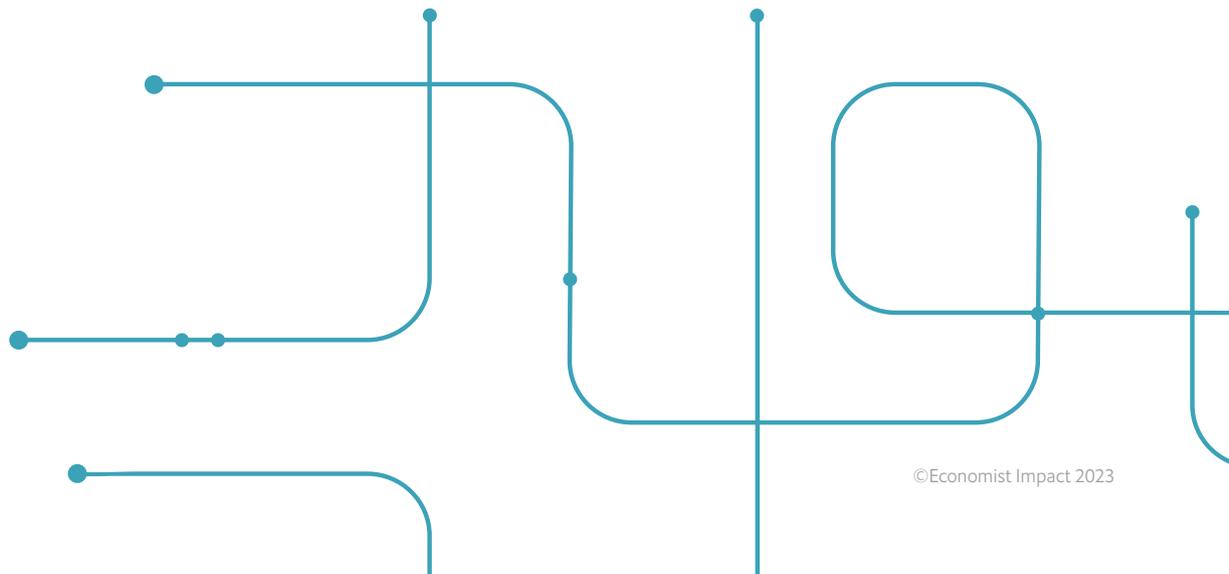
disease progression can be slowed through preventive measures (lifestyle changes, for example) and appropriate therapeutic options. At later stages, treatments can only be used to control associated problems.

"Unfortunately, we often first see patients in the late stages, and we know that if they had come three or four years earlier, we would be more effective in slowing the progression," says Professor Stergiou. "When they come with extensive damage there is little we can do for them. And they are very difficult cases in all aspects ... It's very sad to see."

Disease detection can involve:

A blood test to check how well the kidneys are filtering by looking at the level of a waste product, creatinine. Results are reported as an estimated glomerular filtration rate (eGFR). This simply calculated measurement is used to define the CKD stage.⁴⁸

A urine test to check for albumin, a type of protein. For those with damaged kidneys, albumin is found in their urine.⁴⁹ This simple test, which can be conducted in a non-specialist setting, is not specific for kidney disease. The urinary albumin/creatinine ratio (uACR), after repeated measurement, is preferred currently for staging CKD.⁴⁹



Chapter 2. Prevalence and impact in Europe: a steep rise

CKD prevalence is outpacing other, more recognised NCDs.⁵⁰ Therefore, it poses a significant threat to the sustainability of healthcare systems. As society ages, the impact, in terms of a lower quality of life, is felt by more people.

Europe's growing patient population

Within Europe, CKD is present in one in ten adults.¹ This is expected to rise, largely owing to an ageing population and the increasing prevalence of other risk factors such as diabetes, heart disease and obesity—30% of people over 70 have CKD, and 59% of European adults are overweight or obese, meaning that huge numbers of people are affected by significant CKD risk factors.⁵¹⁻⁵⁴

EU PREVALENCE OF CHRONIC KIDNEY DISEASE (CKD) COMPARED WITH OTHER NON-COMMUNICABLE DISEASES, 2019⁵⁵

- CKD: >55 million (in 28 EU countries)
- Diabetes: >52 million
- Cancer: >17 million
- HIV/AIDS: >680,000

CKD can be seen as an age-related condition exacerbated by vascular disease.³⁵

Table 1: Age-standardised CKD prevalence, death and disability-adjusted life years (DALYs) rates per 100,000 across both sexes in 2019, in ten European countries⁵⁵

	Prevalence rate	Death rate	DALYs
Spain	5,153	11	180
Italy	5,853	9	171
France	5,435	7	140
Belgium	5,849	10	190
The Netherlands	6,316	10	178
Poland	7,381	7	190
Romania	7,210	8	260
Portugal	5,663	13	244
Greece	7,043	15	289
Germany	5,847	15	242

Source: IHME GBD Compare, downloaded with permission⁵⁵

Socioeconomic impacts

If CKD is not detected early and managed properly it becomes very expensive and burdensome for all stakeholders.⁵⁶

Healthcare impacts: costly and unsustainable

According to the European Kidney Health Alliance (EKHA), the disease is among the most expensive for European health systems, estimated to cost them €140bn (US\$150bn) annually.⁴

Direct medical costs for patients with CKD can be quite high, particularly in later stages and in the presence of comorbidities.⁵⁷ If the disease progresses to stage 5, patients in

renal failure will typically undergo dialysis. In Europe, approximately 250,000 patients rely on dialysis for survival, a number that is rising by 5-8% per year.⁵⁸ Based on data from 2015, the most common form of dialysis, haemodialysis, costs approximately €80,000 annually per patient.⁵⁹ Renal replacement therapy usually accounts for 2% of overall health expenditure in Europe, despite only being used for 0.1% of the population.⁵⁹

People with kidney failure may receive a transplant. This is also expensive. It requires a suitable donor, complex surgery and immunosuppressive drugs for life.⁶⁰ Table 2 shows the annual costs of late-stage CKD treatments in Europe.

Table 2: Annual cost of late-stage CKD treatments in Europe (US\$ 2016) per patient^{61, 62}

Late-stage treatment costs vary significantly by country. Of the ten countries focused on in this report, transplants are the most expensive in France and the least expensive in Belgium.

Treatment	Belgium	France	Germany	Greece	Italy	Netherlands	Poland	Portugal	Romania	Spain
Haemodialysis	67,512	85,436	76,642	45,435	46,912	103,187	16,899	32,846	18,445	56,602
Peritoneal dialysis	61,643	69,516	51,196	56,354	26,254	67,974	21,488	32,109	14,271	39,414
Kidney transplant (first year)	38,451	114,220	101,915	63,196	71,461	71,882	-	105,183	-	45,487
Kidney transplant (later years)	8,949	26,660	20,704	10,069	13,969	14,376	-	11,133	-	9,562

Individual impacts: a nightmare for many

Nearly a third of CKD patients report concerns with anxiety or depression.^{47,63} Patients report decreased mobility, cognitive decline, and moderate to severe pain, particularly those in stages 3-5.^{63,64}

A prospective, multicentre study conducted across 11 centres and four countries (Australia, Canada, Spain and New Zealand) found that two-thirds of the patients on dialysis (68%) said that their quality of life was reduced by their illness.⁶³ It severely impacts their ability to work, socialise and live a normal life. In some areas, lack of access to dialysis contributes to this burden.⁶⁵

The personal costs can also be substantial, particularly in the late stages. In general, wealthier patients and/or those living in wealthier nations are more likely to receive regular dialysis.⁶⁶ Those facing out-of-pocket costs may delay, reduce or stop renal replacement therapy or not take medication as prescribed because of cost pressures.^{67,68} In some European countries, patients do not have to pay any out-of-pocket costs, but patients in France, Iceland, the Netherlands, Sweden, and Switzerland must cover 1-25% of costs out-of-pocket.⁶⁹

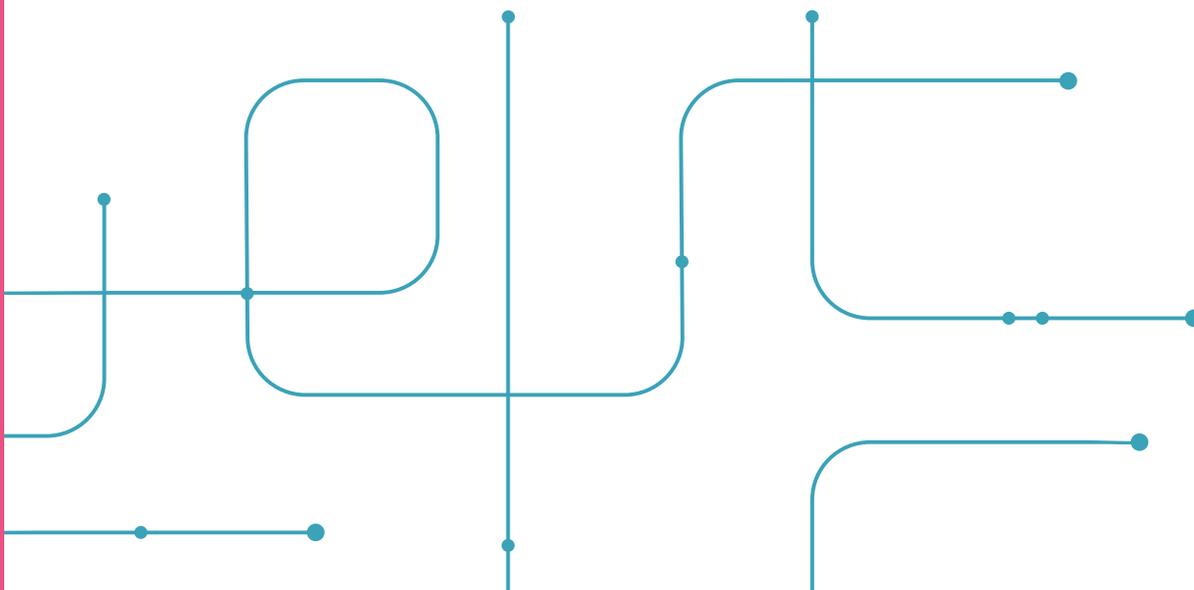
Affected individuals rely heavily on informal caregivers—family and friends—for support, particularly in the later stages of the disease. This can be overwhelming for caregivers, taking a large toll on their emotional, physical, social and economic wellbeing.^{70,71}

Environmental impacts: a large carbon footprint

While often less top of mind, the healthcare sector is a significant contributor to climate change.⁷² In the EU, where the health sector represents nearly 5% of its carbon footprint, there is a collective rise of consciousness around sustainability and active efforts are being made to reduce the sector's impact.^{72,73}

The sector's many activities are being reviewed in consideration of these initiatives, and CKD treatments are no exception. Dialysis is particularly significant, as it requires around 160 billion litres of water each year (equating to about 75,000 litres per patient) and generates over 900,000 tonnes of mainly plastic waste.^{56,74}

Life-sustaining therapies will not be sacrificed, but sustainability pressures could help to spur innovation and encourage earlier diagnosis to reduce the need for what is an economically and environmentally costly treatment.



Chapter 3. Levers to address the CKD epidemic

Given the prevalence and rising incidence rates of CKD across Europe, there is an urgent need to implement better approaches to prevention, management and progression. In this chapter, we explore policy levers for such improvements—identified by our interviewed experts and literature review—and look at where those improvements urgently need to be made.

The CKD epidemic can be addressed from many fronts. This includes:

- **Awareness** among the public, healthcare professionals and policymakers
- Targeted early detection programmes for **high-risk populations**
- Adoption and adherence to **clinical guidelines for best practice disease management**
- Wider adoption of **digital innovations** in CKD detection, monitoring and treatment
- The establishment of **patient registries** and better use of data collected via electronic health records and existing registries

Although we explore each of the above points individually, they are interconnected, with the potential benefits exceeding the sum of their parts. For example, early detection practices are enhanced by better awareness among at-risk populations and medical professionals. Meanwhile, better data collection via registries can help to refine clinical guidelines and early detection strategies.

Awareness and education

Public awareness: few are aware of CKD, its causes or outcomes

Kidneys are among the lesser-known organs. “Everyone is busy looking at the heart, lungs ... Most school children don’t know you have two kidneys,” says Marja Ho-Dac, director of the Dutch Kidney Patient Association in the Netherlands.

“CKD doesn’t make headlines in the mass media, while cancer and stroke are on TV all the time,” adds Luca de Nicola, who is a full professor of nephrology at the University Vanvitelli in Naples, Italy. “We all know heart disease is killing people, but the population is not aware that kidney disease can kill people with heart disease and stroke.”

A global study in 2021 that looked at populations in English speaking countries concluded that CKD awareness among the general public averages 7%.⁷⁵ This does not make for a promising start for CKD awareness.⁷⁵

Even among at-risk groups, awareness is lower than one might expect. One German study found that only 34% of patients with coronary heart disease and impaired kidney function were aware of CKD.⁷⁶ Another European study found that only a third of patients with diabetes had discussed with healthcare professionals how to reduce their risk of kidney disease.⁷⁷

Public awareness matters. Patients and the general public need to understand CKD and its risks in order to ask for screening programmes and undergo screening where it is available. For screening and testing programmes to be effective, patients need to be aware and engaged—particularly those at high risk. And patient awareness is strongly linked with early action and better adherence to preventive action and treatment recommendations.^{15,78} “If you know about your disease from an early stage, you can intervene at a better time before irreversible complications appear,” says Professor Covic.

“If you know about your disease from an early stage, you can intervene at a better time before irreversible complications appear”

Adrian Covic, professor, Internal Medicine and Nephrology, Universitatea de Medicină și Farmacie Grigore T. Popa, Romania

Countries might benefit from multi-channel public awareness campaigns. “The power of social media is huge,” says Isabelle Tostivint, a nephrologist in the Nephrology Department of Pitié Salpêtrière, in France. “I made a video about keeping your kidneys alive and protecting them, and it was seen nearly 2 million times in less than one year.”

Healthcare professionals: greater awareness is urgently needed

The experts that we spoke to unanimously agreed that early detection in primary care is one of the most important policy levers

in terms of curbing the CKD epidemic. Unfortunately, the same experts also told us that although CKD is part of the medical curriculum, most physicians are unaware of the signs that they need to look for when considering a CKD diagnosis.

“It’s important that doctors—primary care as well as specialists—know even simple signs in the urine like proteinuria or albuminuria or increasing creatinine,” says Edgar Almeida, professor of nephrology at the University of Lisbon in Portugal.

Physicians should be encouraged to screen for early-stage CKD as part of their regular screening, detection and management efforts for other chronic diseases. The impact could be significant, as indicated by a 2022 Italian study. In this study, nephrologists trained primary care physicians and aimed to raise awareness around CKD. Six months after this training, the GPs’ use of tests for CKD increased dramatically (by 121% for the albumin-to-creatinine ratio and by 73% for eGFR), especially for at-risk patients. This enabled a 102% increase in the diagnosis of people in stages 3-5.⁷⁹

Limitations in the CKD awareness of healthcare practitioners are not only related to screening. Professor de Nicola notes that cardiologists and primary care physicians still tend to think that the dangerous parts of CKD are the risk factors associated with the disease—namely age, diabetes and hypertension. “But this assumption has been denied by three major meta-analyses that were published in 2012 in *JAMA* and *The Lancet*. These demonstrated that the worst part of a CKD prognosis is the CKD itself. In other words, kidney disease is the most important predictor of clinical outcomes.”

Political stakeholders: CKD unrecognised and underrepresented

National policies and guidelines have also been slow to catch on to the importance of CKD.

When the European Commission launched a new, well-funded (€156m) initiative on chronic disease in mid-2022, it considered five chronic disease areas: heart disease, diabetes, neurological disorders, mental health and chronic respiratory diseases.⁸² CKD did not make the list.

“We objected repeatedly via different channels,” says Raymond Vanholder, president of the European Kidney Health Alliance. “But for the time being, we are unsuccessful. So, kidney disease is not there, which we think is unfair. Policymakers, if they consider kidney disease, rather see it as an appendix to diabetes and cardiovascular diseases. But that’s not correct. It’s something specific, with specific approaches, so then there is a need for a change of mind.”

CKD is also a low priority in many European national policies. Portugal, for example, recently published its ten-year plan for healthcare (covering 2020-30), addressing the main problems in health.⁸³ “We were concerned because CKD doesn’t appear in the main strategy or the main policies for the next decade,” says Professor Almeida. “We don’t understand this. We need to work more with politicians because they ... simply don’t know about CKD.”

Early detection and treatment strategies for high-risk individuals

For a disease where progression is preventable, early detection is the best defence. “If you wait for your patient to feel unwell, it’s far too late and there’s very little you can do to keep them out of transplantation or other interventions to replace the function,” says Professor Stergiou.

Professor Covic adds that early detection and prevention strategies are the only clear means of reversing the CKD epidemic.

“For policymakers, early detection of CKD is the most cost-effective strategy in their arsenal,” agrees Loreto Gesualdo, head of the Nephrology, Dialysis and Transplantation Unit at Università degli Studi di Bari Aldo Moro, Italy.

However, we found early detection programmes have much room for improvement across Europe. Currently, there is no consistent or well-established CKD detection programme in primary care across the countries included in this research. Europe as a whole performs better than other regions for access to free at the point of care acute kidney replacement therapies, but this only applies to people who have received a diagnosis.⁸⁴

Estimates of Europe’s undiagnosed CKD population vary, which, given the difficulties in early detection, is not surprising. One study suggests that while 10% of the population has CKD, another 30% is at risk.² According to a large research study published in *The Lancet*, an estimated two-thirds of affected people in Europe, Canada and Israel are undiagnosed.¹

**“For policymakers,
early detection of
CKD is the most
cost-effective strategy
in their arsenal”**

Loreto Gesualdo, head, Nephrology, Dialysis and Transplantation Unit, Università degli Studi di Bari Aldo Moro, Italy

There are many ways to deploy an early detection programme. For example, population screening (testing of asymptomatic people without risk factors) has been researched and compared with a range of alternative strategies targeted at high-risk individuals.

Findings from researchers in 2006 in Norway, who compared outcomes of different testing strategies, demonstrated the effectiveness of targeted screening versus population-wide screening programmes.⁸⁵

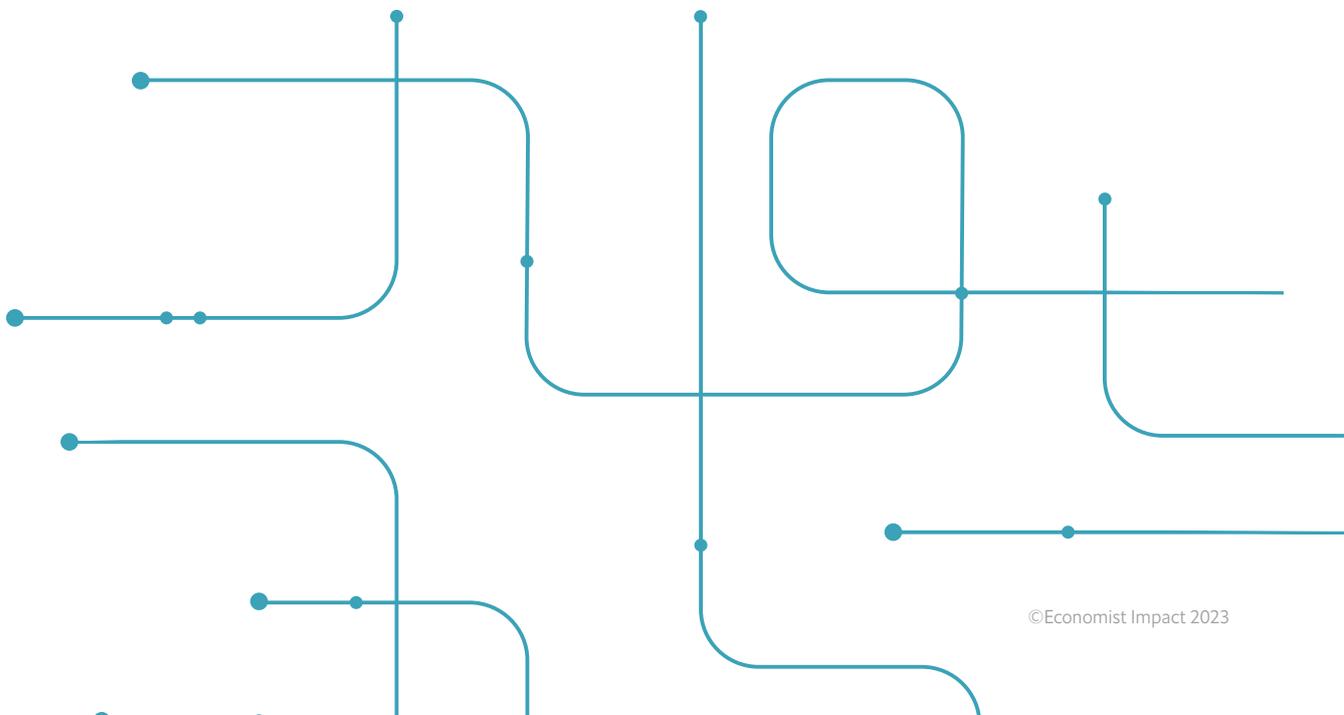
- Overall, 3,069 adults among 65,604 (4.7%) had CKD. A whole-population testing strategy would need to screen 20.6 people to find one case of CKD.
- When only individuals with previously diagnosed diabetes or hypertension were tested, the number of people

needed to be screened per case of CKD discovered dropped to 5.9.

- By testing individuals who have diabetes or hypertension or are aged over 55 years, 8.7 people were screened to detect one new case.

The research highlighted that a person's risk of CKD, rather than age alone, was the most effective strategy (defined as the fewest people screened to detect one case) and should be considered.^{35, 86}

Many healthcare and medical organisations recommend regular testing of at-risk populations for CKD, including those in France (Haute Autorité de Santé), Germany (Deutsche Gesellschaft für Allgemeinmedizin und Familienmedizin), Spain (Sociedad Española de Nefrología), the Netherlands (Huisartsen Genootschap) and the international KDIGO guidelines.⁸⁷⁻⁹⁰



Clinical guidelines

Evidence-based clinical guidelines, which represent a thorough review of the evidence base along with the consensus of a professional group, and sometimes patients, are important tools for many conditions. They are often used as a policy tool for implementing best practice. However, research reveals that many European countries are lacking local guidance or not adhering to the guidance that they have created around CKD.⁹¹

A current evidence-based guideline that many physicians follow has been created by KDIGO, a global non-profit organisation.^{24,92} The organisation produced a toolkit with the International Society of Nephrology (ISN) for the early identification and intervention screening for CKD. They advised that any policy for kidney disease screening should take into account local policies, resource limitations, payment systems and care delivery models.⁹²

Michel Jadoul, who is head of the Nephrology Department at Saint-Luc University Clinics at the Catholic University of Louvain, Belgium, as well as the co-chair of KDIGO, is dismayed by the gap between guidelines and on-the-ground care. “Urine testing is still definitely underused, and I’m fighting to improve that with the medical students and with primary care physicians, and especially among cardiologists ... It should be part of the routine assessment of anyone at high-risk.”

Digital diagnosis and management tools

As with most areas of healthcare, applications of advanced digital technologies could transform CKD diagnosis and management. Telehealth tools notably received a boost amid the COVID-19 pandemic, when healthcare providers needed to manage patients remotely and enable them to engage in self-care and self-reporting.^{93,94}

One study has shown that CKD patients can receive comparable or even better care remotely compared with in-person consultations.⁹⁵ There is a need to fine-tune telehealth to ensure that safety standards are high, particularly for high-risk or elderly patients with complex needs.⁹⁶⁻⁹⁸

Higher levels of digital application, incorporating technologies such as machine learning and artificial intelligence (AI), are also now being used to help reduce the costs of CKD diagnosis and care. For example, an AI-based platform used smartphone cameras to capture and transmit the results of screening home-testing kits to primary care physicians, reducing unnecessary trips to clinics and hospitals.⁹⁹ In another example, AI can use available datasets to develop care plans for some CKD patients, particularly in very advanced dialysis cases.¹⁰⁰ Machine learning can also enable efficient CKD screening, diagnosis and even predictive analytics for kidney-related diseases.¹⁰¹

“We are also working on some research programmes with virtual reality for both educating patients with renal replacement therapy and providing coping mechanisms,” says Professor Covic, although he adds that such technology is “in its infancy.”

The potential for digital health tools remains exciting, but some experts warn of the need for patience—there is still a lot to accomplish. “Innovative technology solutions should be explored, but right now we need more basic information,” says Professor de Nicola. “If we can use technology to improve the pre-dialysis phases, that’s fine, but the major efforts should be for simple things, like [accurate] diagnosis.”

Another tech-based area that shows clear promise to help facilitate early CKD detection, particularly among those who are at risk, is e-health records.¹⁰² In Australia, custom software integrated into primary care e-health records uses a database to identify patients at risk of CKD, allowing for real-time prompting

of clinicians to carry out assessment, testing, diagnosis and management according to best practice.¹⁰³ This has led to an improvement in identifying at-risk patients, appropriate and opportune testing, and increased documentation related to their CKD diagnosis.¹⁰³

E-health records can embed tools and programmes to help clinicians manage care. In a study conducted over 18 months, these tools, combined with reminders and information for patient engagement, led to higher rates of annual testing for CKD.¹⁰⁴

Activating patient registries for better decision-making

Another important policy lever is activating the wider use of patient registries. Patient data, when collected and added to a registry, can impact the full spectrum of CKD planning and care.

CKD registries can:¹⁰³

- help policymakers and clinicians make data-driven decisions¹⁰⁵
- assist with infrastructure planning, outcome reporting and benchmarking, hypothesis-generating, and real-world trials,¹⁰⁶ and
- inform individualised educational resources for patients, policy decisions for policymakers and clinical care pathways for clinicians.¹⁰⁷

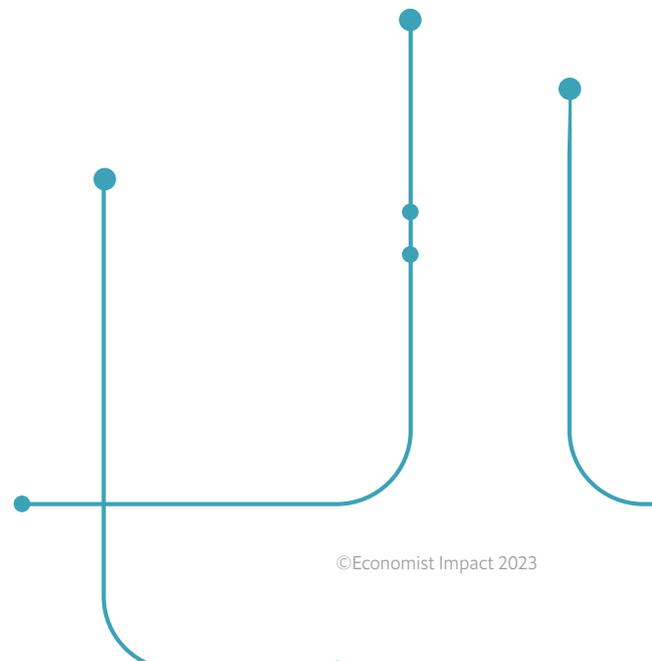
Registry-based tools can facilitate population health strategies across the spectrum of CKD care.¹⁰⁵

Unfortunately, Europe has patchy data on who is living with CKD, and at best data exist largely on those with the later stages of the disease and receiving renal replacement therapy.¹⁰⁶ In terms of best practices, Europe can look towards the US, where a national registry for people at all stages of CKD exists.¹⁰⁸

As an example of the benefits, Professor Covic proudly discusses Romania's registry and the insight it provides: "It only covers those undergoing renal replacement, but it's a perfect registry because any patient that enters dialysis is, by law, obliged to be included," he says.¹⁰⁶ "So, it's a composite registry with full data and very solid analysis."¹⁹

While ideally each registry would track CKD patients in all stages, at a minimum they should track stage 4 and 5 patients and their comorbidities, and those who require some form of renal replacement therapy. Over the past decade, Europe's existing registries have begun to expand the scope of the data that they collect, which has made them more valuable.¹⁹

Another area of deficiency is in the crossover between CKD, diabetes and heart disease. Because diabetes and cardiovascular diseases are contributors to CKD (and are commonly comorbid), there should be greater links to diabetes and heart disease registries. This will offer the opportunity for greater insights into all conditions.



Policy recommendations

The CKD epidemic is currently raging through Europe. Its impact can be reduced by taking a comprehensive look at specific solutions, creating an enabling environment with policies that benefit all stakeholders; the general public, communities and people living with diagnosed or undiagnosed disease, healthcare practitioners, administrators and researchers.

We highlight the following recommendations for policymakers. Recommendations vary across countries and health systems. Policymakers can learn from successful initiatives in other countries.

Educate and build awareness

CKD is not always well recognised by the public, policymakers or healthcare professionals.

The general public

- Engage the general public through media channels that reach larger numbers of people. These are critical to the success of early CKD detection programmes, as the general population is largely unaware of this condition. Population-wide awareness campaigns should increase knowledge about kidney function, kidney disease and CKD risk factors.¹⁵
- Target those most at-risk with awareness and health literacy initiatives. These groups could include the elderly, those with diabetes, hypertension or obesity (see the “Who is at Risk?” section in Chapter 1 for more details). Primary and speciality care settings are examples of environments where these populations may be receptive to messaging around early detection.

- Sponsor media channels for patient organisations to raise awareness of this issue.

Healthcare professionals (especially primary care physicians)

- Initiate targeted clinical education programmes delivered by specialists for primary care practitioners. These are useful routes to increasing awareness and act as a stimulus for integration.
- Enact campaigns motivating primary care physicians to increase their use of CKD testing. One way to do this could be incentives. Ways of identifying high-risk patients efficiently exist in lessons from other countries.
- Encourage primary care physicians to discuss CKD with patients, particularly those at high risk of CKD. This can take extra time, which could be acknowledged in different ways in different health systems.

Political stakeholders (those influencing health and economic systems)

- Increase understanding of how a country’s prosperity is affected by CKD. Realisation can drive health leaders and policymakers to initiate research into the current impacts on affected populations and how to deal with it.
- Reiterate the economic arguments. Policymakers have multiple competing priorities and recent research on CKD may affect their prioritisation of the condition and lead to initiating forums to bring CKD stakeholders together to debate action.
- Revisit national health plans with the latest CKD research in mind.

- Advocate for a national CKD or kidney strategy and integrate this into existing chronic disease plans.

Early detection and treatment

This report is not the first—and nor will it be the last—to strongly recommend early detection programmes for individuals at risk of CKD. CKD is a progressive and irreversible disease not normally detected in the asymptomatic early stages. It is often diagnosed by chance in the later stages, at which point less than a third of kidney function remains.

Early detection can allow people to be offered an evidence-based treatment plan to slow progression and improve symptoms.

Create and optimise an early detection strategy

- Implement early detection for at-risk populations and regularly monitor policies and their targets to identify improvement opportunities. In addition, fund research that can optimise plans by looking at feasibility and acceptability of early detection strategies.
- Work with advocacy groups to design patient-centric early detection programmes and implement them in target communities.
- Create incentives for physicians to screen at-risk patients (such as pay-for-performance programmes or alternative payment models).¹⁵
- Where needed, explore operational efficiencies in screening to remove economic and practical barriers.¹⁵

Target screening for at-risk individuals at the primary care level

- Integrate screening at the primary care level for at-risk individuals at all opportunities. For example, testing individuals for

“This report is not the first—and nor will it be the last—to strongly recommend early detection programmes for individuals at risk of CKD.”

Economist Impact

CKD who fulfil certain criteria at non-kidney related appointments.

- Leverage electronic medical records and digital innovations
- Advocate for an integrated approach to CKD testing when monitoring other NCDs.
- Develop dedicated strategies to optimise and increase the proportion of people screened from minority ethnic groups.
- Evaluate the success of testing programmes and regularly assess efficacy. Share learnings between countries.

Clinical guidelines

- Translate and implement global clinical KDIGO guidelines for early identification and treatment into national pathways and quality improvement systems. Communicate these guidelines broadly.¹⁵
- Develop easy-to-use tools based on guidelines aimed at primary care providers.¹⁵
- Add training on the use of guidelines for CKD care to medical school curriculums.¹⁵

Treatment strategies

- Ensure that available care pathways and treatments reflect the latest clinical guidelines.
- Ensure that CKD is included in disease management strategies for other related NCDs.

- Ensure that there are clear referral pathways for diagnosed individuals. This will help patients navigate a complex health system.

Adopt digital tools for data collection, recording and communication

Europe has no uniform approach to the adoption of digital tools, and most nations are doing very little to utilise the available data on CKD patients through patient registries and e-health records. Without these data, there is little insight to guide research or national policies or adjust treatment plans.

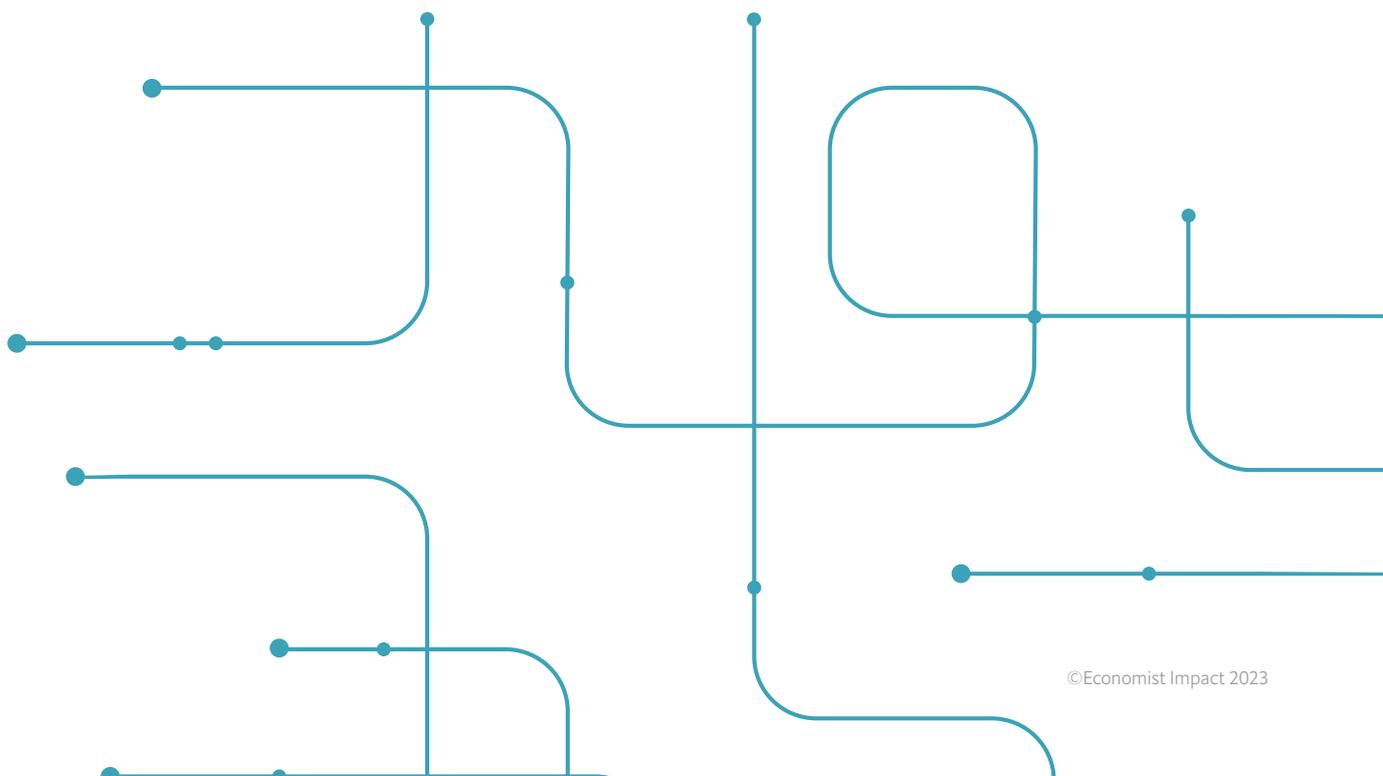
Technical innovations

- Enact clear guidelines for leveraging telemedicine. Ensuring security and confidentiality, this can improve timeliness of care while reducing the travel burden faced by patients.

- Invest in e-health records and develop long-term plans for maximising their potential. Shared standards for data structuring can improve interoperability. Reminders and alerts based on artificial intelligence can be incorporated in e-health records.

Patient registries

- Work towards developing a national renal registry as a priority in countries lacking one.
- Work to ensure that existing registries are expanded to include tracking CKD patients in stage three to better assess the impact of policy interventions for early stages of the disease.
- Incentivise or mandate timely, standardised data entry in registries to better allow insights to be generated quickly for quality improvement.
- Encourage registry data to be analysed and used to update policy, strategies or other programmes associated with CKD detection and management.



References

- ¹ Sundström J, Bodegard J, Bollmann A, et al. Prevalence, outcomes, and cost of chronic kidney disease in a contemporary population of 2.4 million patients from 11 countries: the CaReMe CKD study. *The Lancet Regional Health - Europe*. 2022;20:100438.
- ² Vanholder R, Annemans L, Bello AK, et al. Fighting the unbearable lightness of neglecting kidney health: the decade of the kidney. *Clin Kidney J*. 2021;14(7):1719-30.
- ³ ISN. Statement on behalf of the international society of nephrology (ISN) to the 66th session of the WHO regional committee for Europe on "health in the 2030 agenda for sustainable development and its relation to health 2020" (agenda item 5a). Brussels: International Society of Nephrology, 2016. Available from: https://www.euro.who.int/__data/assets/pdf_file/0019/317332/International-Society-Nephrology-statement.pdf.
- ⁴ EKHA. The decade of the kidney [Internet]. Brussels: European Kidney Health Alliance. Available from: <https://ekha.eu/the-decade-of-the-kidney/>.
- ⁵ Berns J. Routine screening for CKD should be done in asymptomatic adults... selectively. *Clin J Am Soc Nephrol*. 2014;9(11):1988-92.
- ⁶ National Institute of Diabetes and Digestive and Kidney Diseases. Slow progression & reduce complications [Internet]. Bethesda (MD): National Institutes of Health. Available from: <https://www.niddk.nih.gov/health-information/professionals/clinical-tools-patient-management/kidney-disease/identify-manage-patients/manage-ckd/slow-progression-reduce-complications>.
- ⁷ National Kidney Foundation. Self-management, diabetes and chronic kidney disease: a teaching tool for diabetes educators. New York (NY): National Kidney Foundation, 2007. Available from: https://www.kidney.org/sites/default/files/12_10_2095_SelfManagement.pdf.
- ⁸ Molina P, Gavela E, Vizcaíno B, et al. Optimizing diet to slow CKD progression. *Frontiers in Medicine*. 2021;8.
- ⁹ Bello AK, Johnson DW. Educating primary healthcare providers about kidney disease. *Nature Reviews Nephrology*. 2022;18(3):133-4.
- ¹⁰ Narva AS, Norton JM, Boulware LE. Educating patients about CKD: the path to self-management and patient-centered care. *Clin J Am Soc Nephrol*. 2016;11(4):694-703.
- ¹¹ Jankowski J, Floege J, Fliser D, et al. Cardiovascular disease in chronic kidney disease. *Circulation*. 2021;143(11):1157-72.
- ¹² Kumar S, Bogle R, Banerjee D. Why do young people with chronic kidney disease die early? *World J Nephrol*. 2014;3(4):143-55.
- ¹³ Okpechi IG CF, Gaipov A, et al. Early identification of CKD—a scoping review of the global populations. *Kidney Int Rep*. 2022;7(6):1341-53.
- ¹⁴ Subbiah A, Chhabra Y, Mahajan S. Cardiovascular disease in patients with chronic kidney disease: a neglected subgroup. *Heart Asia*. 2016;8(2):56-61.
- ¹⁵ Shlipak MG, Tummalaipalli SL, Boulware LE, et al. The case for early identification and intervention of chronic kidney disease: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. *Kidney International*. 2021;99(1):34-47.
- ¹⁶ National Institute of Diabetes and Digestive and Kidney Diseases. Anemia in chronic kidney disease [Internet]. Bethesda (MD): National Institutes of Health. Available from: <https://www.niddk.nih.gov/health-information/kidney-disease/anemia>.
- ¹⁷ NICE. Chronic kidney disease [Internet]. London: National Institute for Health and Care Excellence Available from: <https://cks.nice.org.uk/topics/chronic-kidney-disease/>
- ¹⁸ NHS. Treatment: chronic kidney disease [Internet]. London: National Health System. Available from: <https://www.nhs.uk/conditions/kidney-disease/treatment/>.
- ¹⁹ Jager KJ, Åsberg A, Collart F, et al. A snapshot of European registries on chronic kidney disease patients not on kidney replacement therapy. *Nephrology Dialysis Transplantation*. 2022;37(1):8-13.
- ²⁰ Stengel B MD, Tu C, et al. Adherence to the kidney disease: improving global outcomes CKD guideline in nephrology practice across countries. *Kidney Int Rep*. 2021;6(2):437-48.
- ²¹ Mayo Clinic. Chronic kidney disease [Internet]. Rochester (MN): Mayo Foundation for Medical Education and Research (MFMER). Available from: <https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>.
- ²² CDC. What you should know about chronic kidney disease [Internet]. Atlanta (GA): Centers for Disease Control and Prevention. Available from: <https://www.cdc.gov/kidneydisease/publications-resources/what-to-know-about-ckd.html#:~:text=Your%20kidneys%20work%20hard,important%20for%20maintaining%20good%20health>.
- ²³ National Institute of Diabetes and Digestive and Kidney Diseases. Your kidneys & how they work [Internet]. Bethesda (MD): National Institutes of Health. Available from: <https://www.niddk.nih.gov/health-information/kidney-disease/kidneys-how-they-work>.
- ²⁴ KDIGO. KDIGO 2012 clinical practice guidelines for the evaluation and management of chronic kidney disease. Brussels: Kidney Disease Improving Global Outcomes, 2013. Available from: https://kdigo.org/wp-content/uploads/2017/02/KDIGO_2012_CKD_GL.pdf.
- ²⁵ Vaidya S, Aeddula N. Chronic renal failure. Treasure Island (FL): StatPearls Publishing. Available from: www.ncbi.nlm.nih.gov/books/NBK535404/.
- ²⁶ World Kidney Day. [Internet]. Twitter: World Kidney Day. Available from: <https://twitter.com/worldkidneyday/status/1370027468753633281>.
- ²⁷ American Kidney Fund. Stages of kidney disease [Internet]. Rockville (MD): American Kidney Fund. Available from: <https://www.kidneyfund.org/all-about-kidneys/stages-kidney-disease>.

- ²⁸ National Institute of Diabetes and Digestive and Kidney Diseases. Hemodialysis [Internet]. Bethesda (MD): National Institutes of Health. Available from: <https://www.niddk.nih.gov/health-information/kidney-disease/kidney-failure/hemodialysis>.
- ²⁹ Clinic C. Dialysis [Internet]. Cleveland (OH): Cleveland Clinic. Available from: <https://my.clevelandclinic.org/health/treatments/14618-dialysis>.
- ³⁰ Mayo Clinic. Peritoneal dialysis [Internet]. Rochester (MN): Mayo Foundation for Medical Education and Research. Available from: <https://www.mayoclinic.org/tests-procedures/peritoneal-dialysis/about/pac-20384725>.
- ³¹ ISN. Early diagnosis of chronic kidney disease. Brussels: International Society of Nephrology, 2021. Available from: https://www3.weforum.org/docs/WEF_CKD_discussion_paper_PHSSR.pdf.
- ³² Responsum for CKD. How fast does chronic kidney disease progress? [Internet]. Washington (DC): Responsum Health. Available from: <https://responsumhealth.com/chronic-kidney-disease/how-fast-does-ckd-progress/>.
- ³³ Drawz P. Delaying progression. Brussels: National Kidney Foundation. Available from: <https://www.kidney.org/sites/default/files/Final%20Session%20%20Drawz%20Delaying%20Progression.pdf>.
- ³⁴ KDIGO. Chronic kidney disease mineral bone disease (CKD-MBD) [Internet]. KDIGO. Available from: <https://kdigo.org/guidelines/ckd-mbd/>.
- ³⁵ Bochud M. On the rationale of population screening for chronic kidney disease: a public health perspective. *Public Health Reviews*. 2015;36(1):11.
- ³⁶ Drawz PE, Rosenberg ME. Slowing progression of chronic kidney disease. *Kidney Int Suppl* (2011). 2013;3(4):372-6.
- ³⁷ MacRae C, Mercer SW, Guthrie B, et al. Comorbidity in chronic kidney disease: a large cross-sectional study of prevalence in Scottish primary care. *British Journal of General Practice*. 2021;71(704):e243-9.
- ³⁸ Lee WC, Lee YT, Li LC, et al. The number of comorbidities predicts renal outcomes in patients with stage 3-5 chronic kidney disease. *J Clin Med*. 2018;7(12).
- ³⁹ Hirst JA, Hill N, O'Callaghan CA, et al. Prevalence of chronic kidney disease in the community using data from OxRen: a UK population-based cohort study. *Br J Gen Pract*. 2020;70(693):e285-e93.
- ⁴⁰ Sarnak M. A patient with heart failure and worsening kidney function. *Clin J Am Soc Nephrol*. 2014;9(10):1790-8.
- ⁴¹ CDC. The surprising link between chronic kidney disease, diabetes, and heart disease [Internet]. Atlanta (GA): Centers for Disease Control and Prevention. Available from: <https://www.cdc.gov/kidneydisease/publications-resources/link-between-ckd-diabetes-heart-disease.html>.
- ⁴² Jdiaa SS, Mansour R, El Alayli A, et al. COVID-19 and chronic kidney disease: an updated overview of reviews. *J Nephrol*. 2022;35(1):69-85.
- ⁴³ Diseases NIoDaDaK. Diabetic kidney disease [Internet]. Bethesda (MD): National Institutes of Health. Available from: <https://www.niddk.nih.gov/health-information/diabetes/overview/preventing-problems/diabetic-kidney-disease>.
- ⁴⁴ National Institute of Diabetes and Digestive and Kidney Diseases. High blood pressure & kidney disease [Internet]. Maryland (AR): National Institutes of Health. Available from: <https://www.niddk.nih.gov/health-information/kidney-disease/high-blood-pressure>.
- ⁴⁵ Luyckx VA, Tuttle KR, Garcia-Garcia G, et al. Reducing major risk factors for chronic kidney disease. *Kidney Int Suppl* (2011). 2017;7(2):71-87.
- ⁴⁶ Bentall A. Chronic kidney disease: overview [Internet]. Rochester (MN): MayoClinic. Available from: <https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>.
- ⁴⁷ Kidney Care UK. Facts about kidneys [Internet]. Alton: Kidney Care UK. Available from: <https://www.kidneycareuk.org/news-and-campaigns/facts-and-stats/>.
- ⁴⁸ Cleveland Clinic. Estimated glomerular filtration rate (eGFR) [Internet]. Cleveland (OH). Available from: <https://my.clevelandclinic.org/health/diagnostics/21593-estimated-glomerular-filtration-rate-egfr#:~:text=Healthcare%20providers%20use%20estimated%20glomerular,dialysis%20or%20a%20kidney%20transplant>.
- ⁴⁹ Keshvari-Shad F, Hajebrahimi S, Pilar Laguna Pes M, et al. A systematic review of screening tests for chronic kidney disease: an accuracy analysis. *Galen Med J*. 2020;9:e1573.
- ⁵⁰ Neuen B, Chadban S, Demaio A, et al. Chronic kidney disease and the global NCDs agenda. *BMJ Glob Health*. 2017;2(2):e000380.
- ⁵¹ Brück K. Epidemiology of chronic kidney disease in Europe [Internet]. Amsterdam: University of Amsterdam. Available from: <https://dare.uva.nl/search?identifier=8bb0bc17-6d4a-4001-a9ba-a643816c9f82>.
- ⁵² Eurostat. Overweight and obesity [Internet]. Luxembourg: Eurostat. Available from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Overweight_and_obesity_-_BMI_statistics.
- ⁵³ EASO. New WHO report: Europe can reverse its obesity "epidemic" [Internet]. Dublin: European Association for the Study of Obesity. Available from: <https://easo.org/new-who-report-europe-can-reverse-its-obesity-epidemic/#:~:text=The%20new%20WHO%20report%20outlines,achieving%20environmentally%20sustainable%20food%20systems>.
- ⁵⁴ WHO. New WHO report: Europe can reverse its obesity "epidemic" [Internet]. Geneva: World Health Organization. Available from: <https://www.who.int/europe/news/item/03-05-2022-new-who-report--europe-can-reverse-its-obesity--epidemic>.
- ⁵⁵ IHME. GBD Compare. [Internet]. Seattle (WA): Institute for Health Metrics and Evaluation, University of Washington Available from: <http://vizhub.healthdata.org/gbd-compare>.
- ⁵⁶ Luyckx VA, Tonelli M, Stanifer JW. The global burden of kidney disease and the sustainable development goals. *Bull World Health Organ*. 2018;96(6):414-22d.
- ⁵⁷ Baumeister SE, Böger CA, Krämer BK, et al. Effect of chronic kidney disease and comorbid conditions on health care costs: A 10-year observational study in a general population. *Am J Nephrol*. 2010;31(3):222-9.
- ⁵⁸ Biebuyck GKM, Neradova A, de Fijter CWH, et al. Impact of telehealth interventions added to peritoneal dialysis-care: a systematic review. *BMC Nephrology*. 2022;23(1):292.
- ⁵⁹ EKHA. Recommendations for sustainable kidney care [Internet]. Brussels: European Kidney Alliance. Available from: <https://ekha.eu/wp-content/uploads/2016/01/EKHA-Recs-for-Sustainable-Kidney-Care-25.08.2015.pdf>.
- ⁶⁰ Gordon E, Prohaska T, Sehgal A. The financial impact of immunosuppressant expenses on new kidney transplant recipients. *Clin Transplant*. 2008;22:738-48.

- ⁶¹ ISN. The global kidney health atlas: Western Europe. Brussels: International Society of Nephrology, 2018. Available from: https://www.theisn.org/wp-content/uploads/media/gkha/Western%20Europe/2.%20GKHA%202019%20regional%20slides_Western%20EU%20v1.2.pdf.
- ⁶² ISN. The global kidney health atlas: Central & Eastern Europe. Brussels: International Society of Nephrology, 2018. Available from: https://www.theisn.org/wp-content/uploads/media/gkha/Eastern%20and%20Central%20Europe/2.%20GKHA%202019%20regional%20slides_East%20Cent%20EU%20v1.2.pdf.
- ⁶³ Krishnan A, Teixeira-Pinto A, Lim WH, et al. Health-related quality of life in people across the spectrum of CKD. *Kidney Int Rep.* 2020;5(12):2264-74.
- ⁶⁴ Jha V, Garcia-Garcia G, Iseki K, et al. Chronic kidney disease: global dimension and perspectives. *Lancet.* 2013;382(9888):260-72.
- ⁶⁵ Himmelfarb J, Vanholder R, Mehrotra R, et al. The current and future landscape of dialysis. *Nature Reviews Nephrology.* 2020;16(10):573-85.
- ⁶⁶ Mushi L, Marschall P, Fleβa S. The cost of dialysis in low and middle-income countries: a systematic review. *BMC Health Services Research.* 2015;15(1):506.
- ⁶⁷ Dodd R, Palagyi A, Guild L, et al. The impact of out-of-pocket costs on treatment commencement and adherence in chronic kidney disease: a systematic review. *Health Policy Plan.* 2018;33(9):1047-54.
- ⁶⁸ Small C, Kramer HJ, Griffin KA, et al. Non-dialysis dependent chronic kidney disease is associated with high total and out-of-pocket healthcare expenditures. *BMC Nephrology.* 2017;18(1):3.
- ⁶⁹ Kelly DM, Anders HJ, Bello AK, et al. International society of nephrology global kidney health atlas: structures, organization, and services for the management of kidney failure in Western Europe. *Kidney Int Suppl* (2011). 2021;11(2):e106-e18.
- ⁷⁰ Ebadi A, Sajadi SA, Moradian ST, et al. Psychological consequences for family caregivers of patients receiving hemodialysis: threat or opportunity? *BMC Psychology.* 2021;9(1):154.
- ⁷¹ Matthews M, Reid J, McKeaveney C, et al. Knowledge requirements and unmet needs of informal caregivers of patients with end-stage kidney disease (ESKD) receiving haemodialysis: a narrative review. *Healthcare.* 2022;10(1):57.
- ⁷² Arup. Health care climate footprint report. Health Care Without Harm, 2019. Available from: https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf.
- ⁷³ Economist Impact. Do no harm: healthcare professionals address sustainability and climate change [Internet]. London: Economist Impact. Available from: <https://impact.economist.com/sustainability/resilience-and-adaptation/healthcare-professional-and-climate-change>.
- ⁷⁴ European Parliament. A systematic EU approach to chronic kidney disease [Internet]. Strasbourg: European Parliament. Available from: https://www.europarl.europa.eu/doceo/document/O-9-2022-000005_EN.html.
- ⁷⁵ Chu CD, Chen MH, McCulloch CE, et al. Patient awareness of CKD: a systematic review and meta-analysis of patient-oriented questions and study setting. *Kidney Med.* 2021;3(4):576-85.
- ⁷⁶ Wagner M, Wanner C, Schich M, et al. Patient's and physician's awareness of kidney disease in coronary heart disease patients - a cross-sectional analysis of the German subset of the EUROASPIRE IV survey. *BMC Nephrol.* 2017;18(1):321.
- ⁷⁷ EKHA. Policy options for kidney health in Europe. Brussels: European Kidney Health Alliance. Available from: <https://ekha.eu/wp-content/uploads/2021/11/EKHA-2014-Important-Issue-for-Europe.pdf>.
- ⁷⁸ Plantinga LC, Tuot DS, Powe NR. Awareness of chronic kidney disease among patients and providers. *Adv Chronic Kidney Dis.* 2010;17(3):225-36.
- ⁷⁹ Pesce F, Pasculli D, Pasculli G, et al. "The Disease Awareness Innovation Network" for chronic kidney disease identification in general practice. *Journal of Nephrology.* 2022;35(8):2057-65.
- ⁸⁰ Hallan SI, Matsushita K, Sang Y, et al. Age and association of kidney measures with mortality and end-stage renal disease. *Jama.* 2012;308(22):2349-60.
- ⁸¹ Mahmoodi BK, Matsushita K, Woodward M, et al. Associations of kidney disease measures with mortality and end-stage renal disease in individuals with and without hypertension: a meta-analysis. *Lancet.* 2012;380(9854):1649-61.
- ⁸² EAACI. Healthier together: the commission launches €156 million initiative on non-communicable diseases in Europe [Internet]. Zurich: European Academy of Allergy and Clinical Immunology. Available from: <https://eaaci.org/news/healthier-together-the-commission-launches-e156-million-initiative-on-non-communicable-diseases-in-europe/>.
- ⁸³ Silva da Costa A, Ribeiro da Silva C, Jakubowski E, et al. Noncommunicable diseases 2030: assessing Portugal's progress towards the noncommunicable disease-related target of the sustainable developmental goals. *Public health panorama.* 2018;04(03):321-9.
- ⁸⁴ Bello AK, Levin A, Tonelli M, et al. Assessment of global kidney health care status. *Jama.* 2017;317(18):1864-81.
- ⁸⁵ Hallan SI, Dahl K, Oien CM, et al. Screening strategies for chronic kidney disease in the general population: follow-up of cross sectional health survey. *Bmj.* 2006;333(7577):1047.
- ⁸⁶ Snyder S, Pendergraph B. Detection and evaluation of chronic kidney disease. *Am Fam Physician.* 2005;72(9):1723-32.
- ⁸⁷ Chenot J, Stracke S, Weckmann G. Versorgung von Patienten mit nicht-dialysepflichtiger Nierenerkrankung in der Hausarztpraxis [Care of patients with kidney disease not requiring dialysis in the family doctor's practice]. Vorgehen Erstdiagnose, 2019. Available from: https://www.degam.de/files/Inhalte/Leitlinien-Inhalte/Dokumente/DEGAM-S3-Leitlinien/053-048_Versorgung%20von%20Patienten%20mit%20nicht-dialysepflichtiger%20Niereninsuffizienz%20in%20der%20Hausarztpraxis/053-048k_CKD_Vorgehen%20Erstdiagnose.%20korrr27-07-2021.pdf.
- ⁸⁸ De Grauw W, De Leest K, Schenk P, et al. Chronische nierschade [Chronic kidney damage]. Utrecht: Nederlands Huisartsen Genootschap, 2018. Available from: <https://richtlijnen.nhg.org/standaarden/chronische-nierschade>.
- ⁸⁹ Haute Autorite De Sante. Maladie rénale chronique de l'adulte [Adult chronic kidney disease]. Paris: Haute Autorite De Sante, 2021. Available from: https://www.has-sante.fr/upload/docs/application/pdf/2021-09/guide_mrc.pdf.

- ⁹⁰ Martínez-Castelao A, Górriz J, Bover J, et al. Documento de consenso para la detección y manejo de la enfermedad renal crónica [Consensus document for detection and management of chronic kidney disease] *Nefrología*. 2014;34(2):243-62.
- ⁹¹ Bello A, Levin A, Manns B, et al. Effective CKD care in European countries: challenges and opportunities for health policy. *Am J Kidney Dis*. 2015;65(1):15-25.
- ⁹² ISN. ISN-KDIGO early screening booklet. Brussels: International Society of Nephrology, 2021. Available from: https://kdigo.org/wp-content/uploads/2019/01/ISN_KDIGO_EarlyScreeningBooklet_WEB.pdf.
- ⁹³ Divyaveer S, Jha V. COVID-19 and care for patients with chronic kidney disease: challenges and lessons. *FASEB Bioadv*. 2021;3(8):569-76.
- ⁹⁴ Zhao B, Zhang L, Ji P, et al. Bridging “office-based care” with the “virtual practice care model”: evolving care for chronic kidney disease patients in the COVID-19 pandemic—and beyond. *Frontiers in Medicine*. 2020;7:568201.
- ⁹⁵ Lew SQ, Sikka N. Telehealth and kidney disease care: role after the public health emergency? *Clin J Am Soc Nephrol*. 2021;16(12):1784-6.
- ⁹⁶ Ladin K, Porteny T, Perugini JM, et al. Perceptions of telehealth vs in-person visits among older adults with advanced kidney disease, care partners, and clinicians. *JAMA Network Open* [Internet]. 2021 2021/12//; 4(12):[e2137193 p.]. Available from: <http://europepmc.org/abstract/MED/34870680>. <https://doi.org/10.1001/jamanetworkopen.2021.37193>. <https://europepmc.org/articles/PMC8649833>.
- ⁹⁷ Stauss M, Floyd L, Becker S, et al. Opportunities in the cloud or pie in the sky? Current status and future perspectives of telemedicine in nephrology. *Clinical Kidney Journal*. 2021;14(2):492-506.
- ⁹⁸ Wang C-s, Ku E. eHealth in kidney care. *Nature Reviews Nephrology*. 2020;16(7):368-70.
- ⁹⁹ K Government. Smartphone technology in bid to revolutionise early detection of kidney disease [Internet]. London: UK Government. Available from: <https://www.gov.uk/government/news/smartphone-technology-in-bid-to-revolutionise-early-detection-of-kidney-disease>.
- ¹⁰⁰ Kent J. Intermountain using artificial intelligence to support kidney health [Internet]. Lowell (MA): Health IT Analytics. Available from: <https://healthitanalytics.com/news/intermountain-using-artificial-intelligence-to-support-kidney-health>.
- ¹⁰¹ Rashed-Al-Mahfuz M, Haque A, Azad A, et al. Clinically applicable machine learning approaches to identify attributes of chronic kidney disease (CKD) for use in low-cost diagnostic screening. *IEEE Journal of Translational Engineering in Health and Medicine*. 2021;9:1-11.
- ¹⁰² Sennaar K. AI applications for managing chronic kidney disease [Internet]. Boston (MA): Emerj Artificial Intelligence Research. Available from: <https://emerj.com/ai-sector-overviews/ai-managing-chronic-kidney-disease/>.
- ¹⁰³ Pefanis A, Botlero R, Langham RG, et al. eMAP:CKD: electronic diagnosis and management assistance to primary care in chronic kidney disease. *Nephrology Dialysis Transplantation*. 2018;33(1):121-8.
- ¹⁰⁴ Sequist TD, Holliday AM, Orav EJ, et al. Physician and patient tools to improve chronic kidney disease care. *Am J Manag Care*. 2018;24(4):e107-e14.
- ¹⁰⁵ Mendu ML, Ahmed S, Maron JK, et al. Development of an electronic health record-based chronic kidney disease registry to promote population health management. *BMC Nephrology*. 2019;20(1):72.
- ¹⁰⁶ Ng MSY, Charu V, Johnson DW, et al. National and international kidney failure registries: characteristics, commonalities, and contrasts. *Kidney International*. 2022;101(1):23-35.
- ¹⁰⁷ NKF. NKF to develop first-ever patient registry for chronic kidney disease [Internet]. Brussels: National Kidney Foundation. Available from: <https://www.kidney.org/news/nkf-to-develop-first-ever-patient-registry-chronic-kidney-disease>.
- ¹⁰⁸ NKF. NKF launches the first-ever national registry for all stages of kidney disease [Internet]. Brussels: National Kidney Foundation. Available from: <https://www.kidney.org/news/national-kidney-foundation-launches-first-ever-national-registry-all-stages-kidney-disease>.

While every effort has been taken to verify the accuracy of this information, Economist Impact cannot accept any responsibility or liability for reliance by any person on this report or any of the information, opinions or conclusions set out in this report. The findings and views expressed in the report do not necessarily reflect the views of the views of the sponsor or interviewees.



LONDON

The Adelphi
1-11 John Adam Street
London WC2N 6HT
United Kingdom
Tel: (44) 20 7830 7000
Email: london@economist.com

GENEVA

Rue de l'Athénée 32
1206 Geneva
Switzerland
Tel: (41) 22 566 2470
Fax: (41) 22 346 93 47
Email: geneva@economist.com

SÃO PAULO

Rua Joaquim Floriano,
1052, Conjunto 81
Itaim Bibi, São Paulo,
SP, 04534-004
Brasil
Tel: +5511 3073-1186
Email: americas@economist.com

NEW YORK

750 Third Avenue
5th Floor
New York, NY 10017
United States
Tel: (1.212) 554 0600
Fax: (1.212) 586 1181/2
Email: americas@economist.com

DUBAI

Office 1301a
Aurora Tower
Dubai Media City
Dubai
Tel: (971) 4 433 4202
Fax: (971) 4 438 0224
Email: dubai@economist.com

WASHINGTON DC

1920 L street NW Suite 500
Washington DC
20002
Email: americas@economist.com

HONG KONG

1301
12 Taikoo Wan Road
Taikoo Shing
Hong Kong
Tel: (852) 2585 3888
Fax: (852) 2802 7638
Email: asia@economist.com

SINGAPORE

8 Cross Street
#23-01 Manulife Tower
Singapore
048424
Tel: (65) 6534 5177
Fax: (65) 6534 5077
Email: asia@economist.com