Inside CKD: predicting the Clinical and Economic Burden of Chronic Kidney Disease in Belgium

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Introduction/Background:

- Chronic kidney disease (CKD) is prevalent in about 10% of the population globally[1]; whereas in Belgium, it is estimated to be prevalent at about 12%[2].
- As patients in early stages remain asymptomatic, only less then half (5,6%) of the prevalent Belgian CKD patients (12%) get screened (eGFR and/or UACR) and only 1 out of 3 (4,4%) get diagnosed[2].
- In addition, CKD patients often suffer from underlying co-morbidities such as type-2 diabetes and hypertension and have an increased risk of cardiovascular and all-cause mortality[3-5]. CKD is, thus, also associated with increased healthcare expenditure.
- The burden imposed by CKD to the Belgian healthcare system is known in context of advanced CKD management by dialysis and renal replacement therapies (RRTs)[6].
- However, the clinical and economic impact of (missed) management of earlier stages of CKD on Belgian healthcare system is less known.
- It is crucial to understand the burden imposed by earlier and mostly undiagnosed stages of CKD to improve outcomes at patient-level but also to inform healthcare policy planning at national and regional levels.

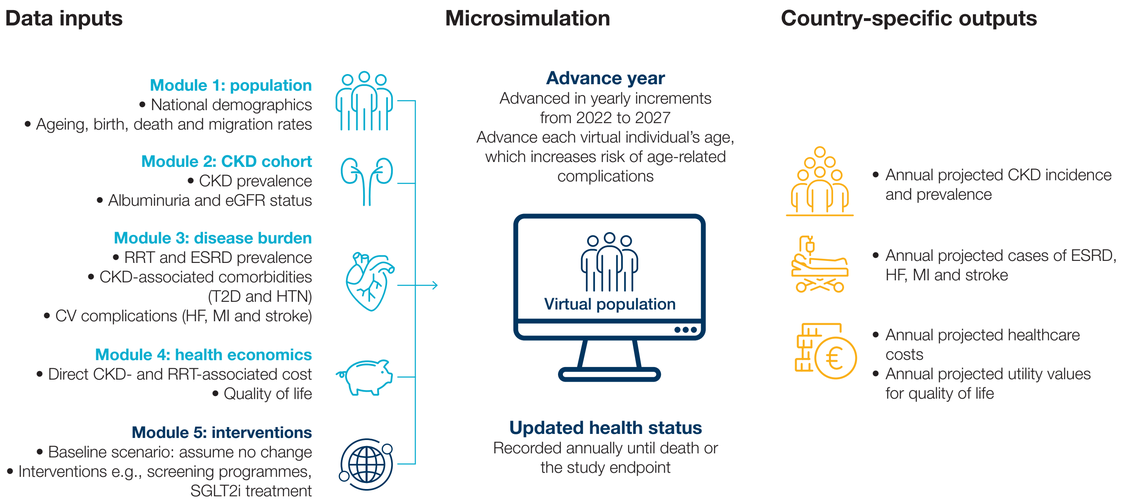
Objective:

- This study (*Inside CKD* henceforth) aims to project the clinical and economic burden of CKD in Belgium between 2022 and 2027 by using patient-level microsimulation modelling[7].

Method:

- The *Inside CKD* microsimulation model constructs virtual, dynamic, and open population cohorts that is enabled to grow over the years within country-specific demographic and prevalence informed based on real-world baseline characteristics (fig.1).

Figure 1 *Overview of the dynamic Inside CKD microsimulation model*



Patient-level microsimulation advances virtual individual in future population by updating their health status based on baseline characteristics and risk-ratios provided.

- The baseline CKD values are assigned by glomerular filtration rate (GFR) and albumin excretion rate (AER) based on prevalence data. The stages were defined according to Kidney Disease Improving Global Outcomes (KDIGO) 2012 recommendations based on GFR and AER values[8].
- Other baseline characteristics were assigned by national data on demographics, mortality, prevalence of CKD, RRTs, comorbidities, related complications, and associated costs.
- Appropriate proxies from the published sources in the UK were used to stratify/categorize input data when such granularity was not available at local level.
- Table 1 describes the input data sources by input types.

Table 1 *Baseline input data and sources*

Parameter	References
National population	
Population estimates	The United Nations (UN), World Population Prospects 2019[9]
Population projection	
Total fertility rate	
Births by mothers' age	
Mortality	
CKD cohort	
eGFR by age category	Health Survey for England (HSE) 2016, UK [10]; Van Pottelbergh et al., 2012[11]
AER by age category	HSE 2016, UK[10]
% of RRT patients on hemodialysis, peritoneal dialysis	Belgian healthcare knowledge centre (KCE) reports 124 C[6]
Transplant rate per dialysis patient year	Belgian Society of Nephrology, 2019[12]
% chance of treatment; annual risk of transplant failure	UK Renal Registry, 2018 (UK)[13]
RRT initiation threshold	assumed
Disease burden	
Proportion of CKD with diabetes; hypertension	HSE 2016, UK [10]; Brazilay et al., 2018 (UK)[14]
HF incidence; prevalence	Devroey et al., 2010[15]; Smeets et al., 2019[16]
MI incidence; prevalence	Belgian federal public service, 201[6][17]; Moran et al., 2012[18]
Stroke incidence; prevalence	Global burden of diseases, 2019[19]
Costs	
Costs by CKD stages	IQVIA hospital disease database
Costs of dialyses, transplants, HF events	IQVIA hospital disease database
GDP; total healthcare expenditure	The World Bank[20]; KCE, 2019[6]

Most inputs were sourced from published Belgian data; however, when extreme granularity were not present (such as eGFR/AER distribution by age-category in CKD patients), the proxies from the UK published literature were used.

- As the model simulates to the next year, everyone in the virtual population advances in age and may have a risk of developing CKD and other co-morbidities, based on baseline kidney function and proportional prevalence of co-morbidities, respectively.
- The relative risks of related complications such as heart failure (HF), myocardial infarction (MI), and stroke are also updated annually.
- This data-driven algorithm is independently developed by HealthLumen and its methodology is fully-validated and published earlier[7].
- Validity assessment was conducted for all input parameters and projected outcomes by country-specific members in the steering committee and published national trends.
- The projected outputs of the microsimulation include the annual prevalence over the years, comorbidities by CKD stage, incidence of complications, and associated costs.

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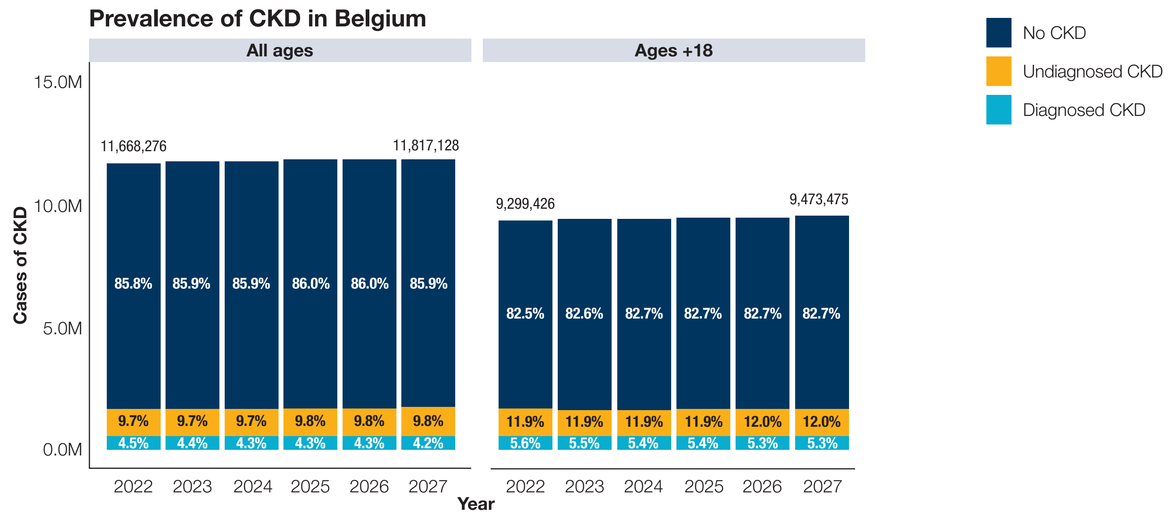
Results:

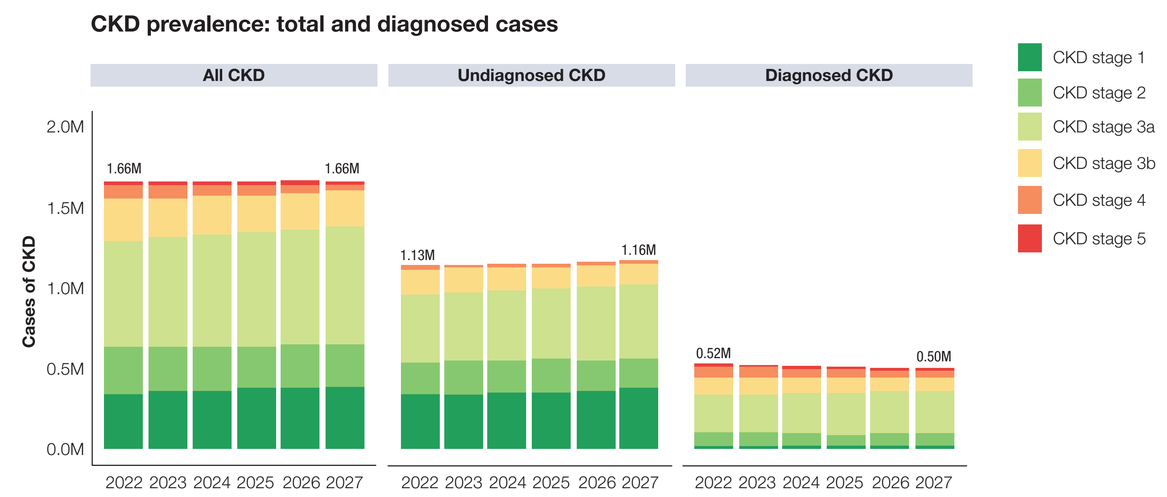
- Without any CKD-related healthcare/policy intervention to the current Belgian healthcare landscape, the prevalence of CKD remains high, 14% in 2027 (fig. 2).
- The diagnosis rates for patients across earlier stages 3a and 3b remain only at 37-40% in 2027 (fig. 3).

Figure 2 *Projected prevalence of CKD in Belgium, in the absence of healthcare/policy interventions*



Until to the progression to stage IV, diagnosis rate remains less than 50%; this situation doesn't improve in the upcoming years (without intervention).

Figure 3 *Prevalence stratified by the stages, both diagnosed and undiagnosed patient*

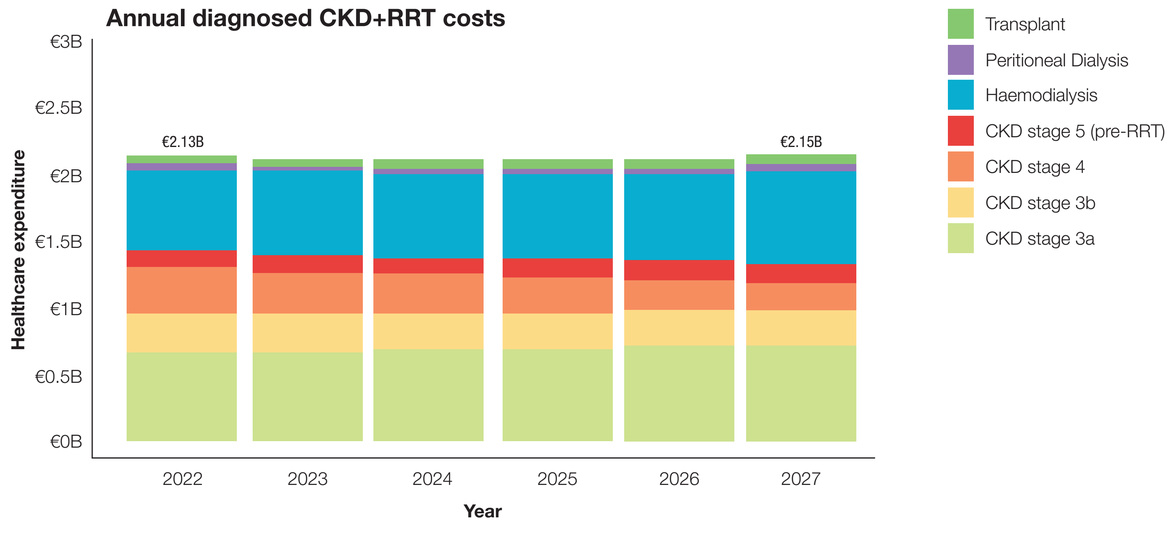


- RRT cases are projected to 17 881, representing an overall growth of 12% versus 2022.
- Out of 231,954 cumulative all-cause deaths in the diagnosed CKD population between 2022 and 2027, ~30% are accounted to stages 3a and 3b.
- Cardiovascular complications – heart failure, myocardial infarction, and stroke - also remain high in the population throughout the projected timeline.
- Out of € 2.15 billion annual healthcare costs projected for CKD, the highest cost (€0.97 billion) was related to stages 3a-3b, followed by that of RRT (€0.8 billion), highlighting the need for preventing future burden but also interventions at the earlier stages (fig. 4 and table 2).

Table 2 *Total annual CKD costs associated with diagnosed CKD and treatments projected over the timeline*

Costs in billion €							
Year	Stage 3a	Stage 3b	Stage 4	Stage 5	Haemodialysis	Peritoneal dialysis	Transplant
2022	0.66	0.29	0.34	0.12	0.62	0.03	0.07
2023	0.68	0.27	0.30	0.12	0.63	0.04	0.07
2024	0.69	0.26	0.28	0.13	0.64	0.04	0.07
2025	0.71	0.25	0.26	0.13	0.65	0.04	0.07
2026	0.72	0.24	0.23	0.15	0.66	0.04	0.07
2027	0.73	0.24	0.20	0.16	0.69	0.04	0.08

Figure 4 *Total annual costs associated with diagnosed CKD management and advanced treatment*



Healthcare expenditure will not only be driven by advanced treatments such as RRT but also earlier disease stages (without intervention).

Conclusions:

- *Inside CKD* demonstrates that without additional healthcare/policy interventions, the burden of CKD in Belgium will remain high in the coming years.
- Not only the severe stages requiring RRT but also the earlier stages impose a huge burden on the Belgian healthcare system.
- National and regional policies aimed at earlier diagnosis and intervention are therefore necessary.

Authors' Disclosures: Vadia R, Vandendriessche E, Maris M, Vankeirsbilck A, Garcia Sanchez J are AZ employees. Meeus G, Mahieu E, Jouret F, Van Pottelbergh G, Jadoul M are independent clinical experts who did not receive any fees or support from AZ in development of this poster. Retat L is employee of HealthLumen that received fees from AZ for developing the model.