Supplementary Information

Projections of clinical burden, healthcare resource utilisation, expenditures and environmental impact for Chronic Kidney Disease in Switzerland

Thomas Campbell-James[1], Stefan Buff[1], Giliane Nanchen[2], Andrew Hall[3], Thomas Rosemann[4], Lindsay Nicholson[5], Stacey Priest[6], Anthony Zara[6], Luke Hubbert[5], Caterina Vecchio Rodriguez[7], George Wharton[8], Menno Pruijm[2]

[1]AstraZeneca AG, Medical Affairs, Baar, Switzerland, [2]Service of Nephrology, University Hospital of Lausanne (CHUV), Lausanne, Switzerland, [3]Zurich Kidney Center, University of Zurich (UZH), Zurich, Switzerland,[4]Department of Primary Care, University of Zurich (UZH), Zurich, Switzerland, [5]Maverex Limited, Newcastle upon Tyne, United Kingdom, [6]EVERSANA, Burlington Ontario, Canada, [7]Swiss Association of Kidney Patients, Zurich, Switzerland, [8]Department of Health Policy, London School of Economics (LSE), London, United Kingdom

Supplemental Table S1: Population generation – Population by age and sex in Switzerland, 2022

Age group	Male	Female	Total
0	41714	39125	80839
1	46068	43822	89890
2	44637	42036	86673
3	44875	42758	87633
4	45924	43606	89530
5	45900	43628	89528
6	46507	44486	90993
7	46601	43793	90394
8	46368	43808	90176
9	45406	42931	88337
10	46015	43133	89148
11	45380	42900	88280

Age group	Male	Female	Total
12	45616	43863	89479
13	45302	42855	88157
14	45192	42512	87704
15	44152	41837	85989
16	43992	41279	85271
17	44088	41119	85207
18	44469	41867	86336
19	44279	41370	85649
20	45248	42163	87411
21	45770	42630	88400
22	49575	45689	95264
23	50097	46743	96840
24	51635	48542	100177
25	53685	50517	104202
26	55633	52945	108578
27	56244	54154	110398
28	58296	55770	114066
29	59966	57901	117867
30	62708	60806	123514
31	64027	61672	125699
32	65173	63238	128411
33	64556	63186	127742
34	65644	63962	129606
35	64405	62388	126793
36	64566	63292	127858
37	64267	62973	127240
38	64437	62822	127259
39	63759	62076	125835
40	64393	63386	127779
41	63784	62574	126358
42	63734	62413	126147
43	61479	60776	122255
44	60691	59732	120423
45	60365	59411	119776
46	59297	59179	118476
47	59059	58616	117675
48	60324	59296	119620
49	59974	59719	119693
50	61807	60771	122578
51	62906	62682	125588
52	63504	63035	126539

Age group	Male	Female	Total
53	64756	64600	129356
54	65708	65449	131157
55	66151	65428	131579
56	67112	65954	133066
57	67402	65522	132924
58	67559	66229	133788
59	64770	63828	128598
60	61407	60950	122357
61	58192	58596	116788
62	56030	56520	112550
63	53373	54494	107867
64	50958	51494	102452
65	48502	49979	98481
66	46574	48124	94698
67	43915	46370	90285
68	41821	45359	87180
69	40027	43783	83810
70	39296	43391	82687
71	37643	41509	79152
72	38121	42297	80418
73	36811	41498	78309
74	36519	41684	78203
75	35498	40643	76141
76	34674	39993	74667
77	32666	37656	70322
78	30968	36767	67735
79	28833	35056	63889
80	26626	32588	59214
81	23604	30195	53799
82	20092	27301	47393
83	18687	25681	44368
84	16849	23867	40716
85	85316	154840	240156

Source: Federal Statistical Office (FSO), 2023 (1)

Supplemental Table S2: Population generation – Proportion of people living with RRT in Switzerland

Age group	Prevalent RRT cases		Transplant Count		Transplant Proportion in General Population		Dialysis Count		Dialysis Proportion in General Population	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
0-19	64	46	56	40	0.0062%	0.0047%	8	6	0.0009%	0.0006%
20-44	614	373	454	276	0.0306%	0.0193%	160	97	0.0108%	0.0068%
45-64	1976	1132	1324	758	0.1076%	0.0621%	632	362	0.0514%	0.0296%
65-74	1348	786	701	409	0.1713%	0.0921%	634	369	0.1548%	0.0832%
75+	1242	717	261	151	0.0737%	0.0311%	981	566	0.2773%	0.1169%

Abbreviations: CKD = chronic kidney disease; RRT = renal replacement therapy.

Source: Calculated using data from ERA-EDTA Registry, 2019 (2)

Supplemental Table S3: Population generation – Proportion of people in Switzerland by eGFR by age and sex

Sex	Patients	Age	90+ (%)	60-89 (%)	30-59 (%)	0-29 (%)
Male	7478	0-24	7283 (97.39)	163 (2.18)	29 (0.39)	3 (0.04)
	9047	25-34	8486 (93.8)	525 (5.80)	24 (0.27)	12 (0.13)
	11703	35-44	10322 (88.20)	1324 (11.31)	44 (0.38)	13 (0.11)
	15216	45-54	11600 (76.24)	3468 (22.79)	122 (0.80)	26 (0.17)
	18452	55-64	11546 (62.57)	6407 (34.72)	441 (2.39)	58 (0.31)
	14644	65-74	4908 (33.52)	8361 (57.10)	1242 (8.48)	133 (0.91)
	14249	75+	1030 (7.23)	8611 (60.43)	3984 (27.96)	624 (4.38)
Female	9414	0-24	9148 (97.17)	234 (2.49)	23 (0.24)	9 (0.10)
	12042	25-34	11351 (94.26)	655 (5.44)	25 (0.21)	11 (0.09)
	14529	35-44	12811 (88.18)	1655 (11.39)	48 (0.33)	15 (0.10)
	17007	45-54	12874 (75.7)	3969 (23.34)	148 (0.87)	16 (0.09)
	19359	55-64	11680 (60.33)	7170 (37.04)	466 (2.41)	43 (0.22)
	15958	65-74	5262 (32.97)	9223 (57.80)	1391 (8.72)	82 (0.51)
	19349	75+	955 (4.94)	11525 (59.56)	6066 (31.35)	803 (4.15)

Abbreviations: eGFR = estimated glomerular filtration rate.
Source: FIRE project (3)

Supplemental Table S4: Population generation – Proportion of people in Switzerland by albuminuria by age and sex

Sex	Patients	Age	0-29 (%)	30-299 (%)	300+ (%)
Male	222	0-24	174 (78.38)	42 (18.92)	6 (2.7)
	385	25-34	343 (89.09)	33 (8.57)	9 (2.34)
	906	35-44	781 (86.2)	114 (12.58)	11 (1.21)
	2096	45-54	1794 (85.59)	270 (12.88)	32 (1.53)
	3706	55-64	3048 (82.25)	571 (15.41)	87 (2.35)
	3886	65-74	2976 (76.58)	776 (19.97)	134 (3.45)
	3719	75+	2432 (65.39)	1093 (29.39)	194 (5.22)
Female	261	0-24	204 (78.16)	48 (18.39)	9 (3.45)
	497	25-34	417 (83.90)	65 (13.08)	15 (3.02)
	828	35-44	731 (88.29)	86 (10.39)	11 (1.33)
	1657	45-54	1463 (88.29)	176 (10.62)	18 (1.09)
	2701	55-64	2359 (87.34)	306 (11.33)	36 (1.33)
	3093	65-74	2595 (83.90)	449 (14.52)	49 (1.58)
	3696	75+	2731 (73.89)	875 (23.67)	90 (2.44)

Source: FIRE project (3)

Supplemental Table S5: CKD characteristics – Diagnostic rates by CKD stage

Age (years)	% of CKD patients at a stage that are diagnosed
Stage 1	2.9%
Stage 2	18.0%
Stage 3a	43.5%
Stage 3b	58.6%
Stage 4	79.1%
Stage 5	100%

Source: Hirst et al., 2020 (UK proxy) (4)

Supplemental Table S6: Population generation – Prevalence of diabetes by age and sex

Age (years)	Diagnosed (%)	95%CI
Males		
18-39	0.9	0.3-2.3
40-49	2.0	1.1-3.7
50-59	7.3	5.3-10.1
60-69	17.0	13.1-21.7
70-79	22.0	17.6-27.2
80-89	26.3	26.2-26.4
90-99	24.1	23.9-24.4
100+	16.5	14.4-18.6
All male	7.0	6.0-8.1
Females		
18-39	3.7	2.5-5.5
40-49	4.5	3.0-6.8
50-59	4.0	2.6-6.0
60-69	10.7	8.2-13.8
70-79	21.8	17.6-26.7
80-89	24	24.0-24.1
90-99	24.9	24.8-25.0
100+	17.7	17.0-18.5
All female	7.4	6.5-8.5

Abbreviations: CI = confidence interval.

Source: Heidemann et al., 2013 (5); Tamayo et al., 2016 (6) (German proxies)

Supplemental Table S7: Population generation – Prevalence of hypertension by age and sex

Age	% with hypertension
Males	
18-29	8.1
30-39	7.2
40-49	19.9
50-59	23.4
60-69	23.8
70-79	30.7
All male	18.1
Females	
18-29	0.9
30-39	2.3
40-49	8.2
50-59	15.3
60-69	21.7
70-79	32.8
All female	12.7

Source: Neuhauser et al., 2013 (7) (German proxy)

Supplemental Table S8: Population generation – Prevalence of heart failure by age

Age (years)	Patients at risk (per 100,000)
≤49	67
50-54	751
55-59	1,300
60-64	2,390
65-69	4,210
70-74	6,970
75-79	11,800
80-84	18,200
85-89	25,600
≥90	33,600

Source: Störk et al., 2017 (8) (German proxy)

Supplemental Table S9: Population generation – Prevalence of history of myocardial infarction by age and sex

Age group (years)	Male (%)	Female (%)
40-49	2.3	0.6
50-59	3.8	0.1
60-69	11.9	4.7
70-79	15.3	6.0

Source: Gößwald et al., 2013 (9) (German proxy)

Supplemental Table S10: Population generation – Prevalence of history of stroke by age and sex

Age group (years)	Male (%)	Female (%)
40-49	0.7	1.1
50-59	1.8	0.8
60-69	5.4	3.1
70-79	8.1	6.3

Source: Busch et al., 2013 (10) (German proxy)

Supplemental Table S11: Population generation (CKD) – Prevalence of comorbidities by CKD stage

Comorbidity	Stage 1	Stage 2	Stage 3a	Stage 3b	Stage 4	Stage 5	Source
Diabetes	23.1%	30%	32.9%	32.9%	53.8%	53.8%	USRDS, 2023 (11) (US proxy)
Hypertension	20.1%		31.9%	35.4%	8.9%		Schneider et al., 2018 (12) (German proxy)
Heart Failure	24%	37%	40%	47%	59%		Beck et al., 2015 (13) (German proxy)

Abbreviations: CKD = chronic kidney disease; US = United States; USRDS = United States Renal Data System.

Supplemental Table S12: Population generation (CKD) – History of CV events by CKD stage

CV event	Stage 1	Stage 2	Stage 3a	Stage 4	Stage 5	Source
MI	7.8%	7.8%	7.8%	11.4%	11.4%	USRDS 2022 (14) (US proxy)
Stroke	11.9%	11.9%	11.9%	14.6%	14.6%	USRDS 2022 (14) (US proxy)

Abbreviations: CKD = chronic kidney disease; CV = cardiovascular; MI = Myocardial Infarction; US = United States; USRDS = United States Renal Data System.

Supplemental Table S13: Kidney transplantation model inputs

Parameter	Value	Source
eGFR eligibility threshold (mL/min/1.73 m^2)	15	Expert opinion
Percentage of eligible patients receiving transplant		
Percentage of incident RRT patients who receive a transplant[a]	19.07%	Statista, 2021 (15) (German proxy)
Proportion of patients transitioning to transplant after initial dialysis[b]		
HD – year 1	5.6%	UK Renal Registry, 2022 (16)
HD – year 3	14.6%	
HD – year 5	18.3%	
PD – year 1	14.7%	
PD – year 3	33.3%	
PD – year 5	39.1%	

[a]Calculated using the total kidney transplants in 2019 (25.9 per million people), and total kidney transplant waiting list (10,325) in 2019.

[b]Proportion of patients transitioning to transplant for patients on HD was used for both home- and clinic-based HD.

Abbreviations: eGFR = estimated glomerular filtration rate; HD = hemodialysis; PD = peritoneal dialysis; RRT = renal replacement therapy; UK = United Kingdom.

Supplemental Table S14: Dialysis model inputs – Percentage of eligible patients by eGFR

Parameter	Value	Source
Age eligibility threshold	75 years	Expert opinion
Probability of dialysis		
15-19 mL/min/1.73m^2	0%	Assumption
10-14 mL/min/1.73m^2	0%	
5-9 mL/min/1.73m^2	100%	Chan et al., 2019 (17): a specified eGFR value for initiation dialysis has not been established (usually based on symptoms); often between 5-10 Mean eGFR of incident RRT patients within 30 days = 10.4 (de Pinho et al., 2022 (18))
<5 mL/min/1.73m^2	100%	
Probability of Modality		
Hemodialysis	91.7%	ERA Registry Annual Report 2021. 2023 (19)
Peritoneal dialysis	8.3%	

Abbreviations: ERA = European Renal Association; eGFR = estimated glomerular filtration rate; RRT = renal replacement therapy.

Supplemental Table S15: Event risk – Incidence of acute myocardial infarction by age and sex for the general population

Age group (years)	Male (per 100,000)	Female (per 100,000)
25-54	101	20
55-64	342	81
65-74	632	248
75-84	1,120	614

Source: Krämer et al., 2021 (20) (German proxy)

Supplemental Table S16: Event risk – Incidence of stroke by age and sex for the general population

Age group (years)	Male (%)	Female (%)
<50	0.05	0.03
50-54	0.23	0.12
55-59	0.39	0.19
60-64	0.54	0.27
65-69	0.75	0.43
70-74	1.01	0.60
75-79	1.39	1.00
80-84	1.65	1.35
85-89	1.93	1.88
≥90	1.77	1.98

Source: Stahmeyer et al., 2019 (21) (German proxy)

Supplemental Table S17: Event risk – Incidence of acute kidney injury for the general population

Age (years)	Incidence rates (per million person-years)
<20	24.4
20-29	73.33
30-39	102.55
40-49	170.59
50-59	394.27
60-69	1081.97
70-79	2824.71
>79	6300.50

Source: Matrisch et al., 2023 (22) (German proxy)

Supplemental Table S18: Event risk – Incidence of hospitalization due to heart failure for the general population

Characteristic	Rate per 100 patient-year
Age <70	14.1
Age 70-79	18.1
Age 80-89	26.9
Age ≥90	35.2

Source: Lawson et al., 2019 (23) (UK Proxy)

Supplemental Table S19: Event risk – CKD-specific relative risk of myocardial infarction by CKD stage

	Age 20-64		Age 65+	
CKD Stage	**Relative Risk**	**95% CI**	**Relative Risk**	**95% CI**
1	1.19	0.64 – 2.22	1.01	0.83 – 1.23
2	1.19	0.64 – 2.22	1.01	0.83 – 1.23
3	2.06	1.48 – 2.87	1.38	1.26 – 1.51
4	2.06	1.48 – 2.87	1.38	1.26 – 1.51
5	2.06	1.48 – 2.87	1.38	1.26 – 1.51

Abbreviations: CI = confidence interval; CKD = chronic kidney disease.
Source: U.S. Renal Data System, 2009 (24) (US proxy)

Supplemental Table S20: Event risk – CKD-specific hazard ratios for incidence of stroke by eGFR and UACR status

eGFR ($ml/min/1.73m^2$)	Normal albuminuria (< 30 mg/g)	Microalbuminuria (30-300 mg/g)	Macroalbuminuria (> 300mg/g)
>90	Reference	1.53	1.94
60-90	1.14	1.75	2.22
30-60	1.64	2.50	3.17
15-30	2.78	4.26	5.40
<15	2.78	4.26	5.40

Abbreviations: CKD = chronic kidney disease; eGFR = estimated glomerular filtration rate; g = grams; mg = milligrams; UACR = urinary albumin-creatinine ratio.
Source: Masson et al., 2015 (25) (Multinational proxy)

Supplemental Table S21: Event risk – CKD-specific relative risk of AKI by CKD stage and age

CKD Stage (eGFR, ml/min/1.73m^2)	Relative Risk
1 (>90)	-
2 (60-89)	0.99
3a (45-59)	1.14
3b (30-44)	1.67
4 (15-29)	5.49
5 (<15)	5.49

Abbreviations: AKI = acute kidney injury; CKD = chronic kidney disease; eGFR = estimated glomerular filtration rate.

Source: Grams et al., 2015 (26) (Multinational proxy)

Supplemental Table S22: Event risk – CKD-specific rate ratios of hospitalization due to HF by CKD category

CKD category	Rate Ratio
eGFR >45, UACR <300	1.0 (reference)
eGFR <45, UACR <300	2.3
eGFR >45, UACR >300	2.9
eGFR <45, UACR >300	3.0

Note: Source model adjustments include age, sex, and race/ethnicity, diabetes, history of cardiovascular disease, use of lipid-lowering medications, smoking, systolic blood pressure, and body mass index, use of diuretics, ACE inhibitors/ARBs and β-blocker.

Abbreviations: ACE Angiotensin-converting enzyme; ARB = Angiotensin receptor blockers; eGFR = estimated glomerular filtration rate; HF = heart failure; UACR = urinary albumin creatinine ratio.

Source: Bansal et al., 2019 (27) (US proxy)

Supplemental Table S23: Event risk – Outcomes of AKI

Outcome	Proportion of patients	One-time eGFR decline reduction
Full recovery (defined as return to baseline serum creatinine)	43%	0
Partial recovery (defined as return to serum creatinine is within 1.5 times the baseline value)	30%	12.5%[a]
No recovery (defined as return to serum creatinine is above 1.5 times the baseline value)	27%	25%[b]

[a] As a conservative assumption using the RIFLE severity classification (i.e., increased creatinine of 1.5-fold is similar to a >25% eGFR decline), patients in partial recovery were assumed to have a one-time eGFR reduction of 12.5%.

[b] As a conservative assumption using the RIFLE severity classification (i.e., increased creatinine of 1.5-fold is similar to a >25% eGFR decline), patients who did not recover were assumed to have a one-time eGFR reduction of 25%.

Abbreviations: AKI = acute kidney injury; eGFR = estimated glomerular filtration rate; RIFLE = Risk, Injury, and Failure; and Loss; and End-stage kidney disease.

Source: Duarte et al., 2022 (28) (Brazilian proxy)

Supplemental Table S24: Mortality events – Relative risk of all-cause mortality by CKD Stage

eGFR (mL/min/1.73m^2)	Albumin excretion rate		
	A1: Normal to mild albuminuria (<30mg/24h)	A2: Microalbuminuria (30-300mg/24h)	A3: Macroalbuminuria (>300mg/24h)
≥90	Reference group	1.5	3.1
60-90	1.0	1.7	2.3
45-60	1.3	2.2	3.6
30-44	1.9	3.3	4.9
15-30	5.3	4.7	6.6
<15	5.3	4.7	6.6

Assumptions: RR for albumin excretion rate <10 in that figure are included as risks for A1 as these are the most conservative; eGFR 90-105 in that figure is taken as the reference group for G1 (eGFR>90); eGFR 15-30 in that figure is taken as the relative risk for G5 (eGFR<15).

Abbreviations: CKD = chronic kidney disease; eGFR = estimated glomerular filtration rate; h = hours; mg = milligrams.

Source: Adapted from Levey et al, 2011 (29) (Multinational proxy)

Supplemental Table S25: Mortality events – Probability of transplant patient survival in Switzerland

	Survival (%)
0 years	100.00%
1 year	97.80%
2 years	96.00%
4 years	92.90%
6 years	88.30%
8 years	83.80%
10 years	79.20%

Source: Digitized from Branca-Dragan et al., 2023 (30)

Supplemental Table S26: Mortality events – Probability of mortality by associated event

Events	Rates	Source
MI	Women: 24% Men: 25.4%	Asaria et al., 2022 (31)[a]
Stroke	21.24%	Koton et al., 2014 (32)[b]
AKI	Stage 1: 5.1% Stage 2: 13.7% Stage 3: 24.8%	Khadzhynov et al., 2019 (33)[c]
HF	11%	Jones et al., 2019 (34)
Dialysis	1 year: 16% 2 years: 27.6% 5 years: 58.6%	ERA-EDTA Annual Report 2021 (2) (Aggregate, does not include Switzerland)

[a]Based on a large, retrospective study using linked data from national databases on hospitalizations and deaths with MI from 2015 to 2018.

[b] Calculated as a cumulative 1-year mortality after incident stroke. Based on a prospective study of 15,792 residents in four US communities aged 45 to 64 years.

[c] Calculated as in-hospital mortality rate. Data obtained from a retrospective study of 185,760 hospitalizations associated with AKI from 2014-2017.

Abbreviations: AKI = acute kidney injury; HF = heart failure; MI = myocardial infarction

Supplemental Table S27: Mortality events – General population mortality rates per 100 000 person, 2022

Age group (years)	Male	Female
<1	4.2	3.3
1 to 14	8.5	10.0
15 to 44	57.5	30.3
45 to 64	375.0	219.2
65 to 84	2568.0	1743.0
> 84	15907.0	13775.0

Source: Federal Statistical Office, 2023 (35,36)

Supplemental Table S28: Comorbidities risk – Incidence of diabetes by age and sex for the general population

Age (years)	Males (%)	Females (%)
18-34	0.10	0.16
35-49	0.68	0.46
50-64	1.90	1.30
65-79	2.50	2.50
≥80	3.20	2.90

Source: National Diabetes Surveillance, 2019 (37) (German proxy)

Supplemental Table S29: Comorbidities risk – Incidence of hypertension by age and sex for the general population

Age	Male (2-year incidence, per 100 persons)	Female (2-year incidence, per 100 persons)
30-39	3.32	1.44
40-49	4.46	3.59
50-59	4.72	5.01
60-69	5.66	6.92
70-79	6.25	8.61

Source: Framingham Study, Dannenberg 1988 (38) (US proxy)

Supplemental Table S30: Comorbidities risk – Incidence of heart failure by age and sex for the general population

Age (years)	Male (per 100,000 persons at risk)	Female (per 100,000 persons at risk)
≤49	55	31
50-54	325	179
55-59	527	306
60-64	771	559
65-69	1173	924
70-74	1781	1450
75-79	2705	2342
80-84	3616	3448
85-89	4855	4251
≥90	5177	4601
All	645	665

Source: Störk et al., 2017 (8) (German proxy)

Supplemental Table S31: Comorbidities risk – CKD-specific relative risk of T2DM by CKD stage

CKD Stage	Relative Risk
1	1.24
2	1.24
3a	1.24
3b	1.24
4	1.24
5	1.24

Note: HR of developing diabetes in overall CKD is 1.24
Abbreviations: CKD = chronic kidney disease; HR = hazard ratio; T2DM = type 2 diabetes mellitus.
Source: Lin et al., 2019 (39) (Taiwan proxy)

Supplemental Table S32: Comorbidities risk – CKD-specific relative risk of heart failure by CKD stage and age

CKD Stage	Relative Risk	95% CI
Aged 20-64 years		
1	1.49	1.14–1.95
2	1.49	1.14–1.95
3	2.96	2.56–3.41
4	2.96	2.56–3.41
5	2.96	2.56–3.41
Aged 65+ years		
1	1.45	1.33–1.68
2	1.45	1.33–1.68
3	1.68	1.61–1.75
4	1.68	1.61–1.75
5	1.68	1.61–1.75

Abbreviations: CI = confidence interval; CKD = chronic kidney disease.

Source: U.S. Renal Data System 2009 (24) (US proxy)

Supplemental Table S33: Comorbidities risk – CKD-specific relative risk of hypertension by CKD stage

CKD Stage (eGFR, mL/min/1.73m^2)	Relative Risk
1 (>90)	1.33
2 (60-89)	1.33
3a (45-59)	1.33
3b (30-44)	1.33
4 (15-29)	1.33
5 (<15)	1.33

Abbreviations: CKD = chronic kidney disease; eGFR = estimated glomerular filtration rate; HTN = hypertension.

Source: Hounkpatin et al., 2020 (40) (UK proxy)

Supplemental Table S34: Annual resource burden associated with CKD

CKD Stage/Treatment modality	ER visits per year	Hospitalizations per year	Outpatient visits per year
Stage 1	0	0	0
Stage 2	0.304246	0.495608	2.678467
Stage 3a	0.332568	0.544815	2.770741
Stage 3b	0.450719	0.688983	3.076986
Stage 4	0.553543	0.947778	4.039855
Stage 5	0.834935	2.449808	9.987087
Stage 5, Transplant	0.834935	2.449808	9.987087
Stage 5, Dialysis	0.834935	2.449808	9.987087

Abbreviations: CKD = chronic kidney disease; ER = emergency room.
Source: DISCOVER CKD, Heerspink et al., 2024 (41)

Supplemental Table S35: Cost of undiagnosed CKD relative to the cost of diagnosed CKD

CKD Stage	Relative difference[a]	Cost increase in year of diagnosis[b]
1	86%	-
2	86%	-
3	86%	-
4	78%	26%
5 (pre-RRT)	70%	26%
5 (Palliative care)	70%	26%

Abbreviations: CKD = chronic kidney disease; RRT = renal replacement therapy.
Source: [a]Chen et al, (Data on File, 2024) (42), [b]Spencer et al., 2023 (43)

Supplemental Table S36: Annual per patient costs associated with treatment of CKD by stage and treatment modality

Condition	Cost (€)	Year	Cost (CHF; Inflated to 2022)*	Source	Definition
CKD stage related costs					
CKD Stage 1	Assumed 0	-	Assumed 0	-	
CKD Stage 2	Assumed 0	-	Assumed 0	-	
CKD Stage 3a	3,692	2014	6,451.80	Gandjour et al., 2020 (44)	Table 2 in reference. Cost for medication, outpatient care, therapeutic aids, medical aids, sick benefits, dentist. Excludes hospitalizations.
CKD Stage 3b	3,720		6,500.73		
CKD Stage 4	4,319		7,547.49		
CKD Stage 5 (pre-RRT)	11,074		19,351.90		Table 2 in reference (dialysis group). Cost for medication, outpatient care, therapeutic aids, medical aids, sick benefits, dentist. Exclude hospitalization and dialysis.
Renal replacement therapy related costs					
Hemodialysis	47,501	Assume 2022	73,395.85	Shukri et al., 2022 (45)	Includes costs of outpatient services, drug expenses ($8,144), sick pay, therapeutic aids, in patient services, and rehabilitation.
Peritoneal Dialysis	46,235		71,439.70		
Transplant	88,932	2006	298,919.2862	Kleophas et al., 2007 (46)	First year costs of transplant including operation.
Transplant Maintenance	9,250		31,091.21		Cost of transplant maintenance in years subsequent to functioning transplant.
Stroke			20,266.17		
Acute Kidney Failure			27,532.87		
Hospitalization for HF			13,430		

Note: *German data from Gandjour et al. (2020) (44), Shukri et al. (2022) (45), and Kleophas et al., (2007) (46), and conversion via Wieser et al. (unpublished; based on Wieser et al. [2014] (47) and OECD (48)) Calculated as Cost*MKF*PKF*ZKF (MKF = quantity correction factor; PKF = price correction factor; ZKF = time correction factor).

Abbreviations: AKI = acute kidney injury; CHF = Swiss francs; CKD = chronic kidney disease; HF = heart failure; MI = myocardial infarction; RRT = renal replacement therapy.

Supplemental Table S37: Employed by age and sex

Age Group	Number employed (Proportion of population)		
	Male	Female	Both Sexes
15-19	569 000 (0.294)	437 000 (0.237)	1 006 000 (0.266)
20-24	1 620 000 (0.689)	1 404 000 (0.653)	3 024 000 (0.672)
25-29	2 008 000 (0.826)	1 756 000 (0.776)	3 764 000 (0.802)
30-34	2 581 000 (0.880)	2 165 000 (0.786)	4 746 000 (0.834)
35-39	2 409 000 (0.898)	2 064 000 (0.797)	4 473 000 (0.849)
40-44	2 306 000 (0.894)	2 111 000 (0.822)	4 417 000 (0.858)
45-49	2 138 000 (0.90)	2 034 000 (0.834)	4 172 000 (0.867)
50-54	2 818 000 (0.889)	2 522 000 (0.821)	5 340 000 (0.855)
55-59	2 915 000 (0.847)	2 674 000 (0.774)	5 589 000 (0.810)
60-64	1 924 000 (0.657)	1 698 000 (0.567)	3 622 000 (0.611)
65-69	488 000 (0.206)	364 000 (0.141)	852 000 (0.172)
70-74	206 000 (0.107)	113 000 (0.051)	319 000 (0.077)
75-79	80 000 (0.052)	44 000 (0.023)	124 000 (0.036)
80+	34 000 (0.015)	17 000 (0.005)	51 000 (0.009)

Source: OECD Data, 2021 (49) (German proxy)

Supplemental Table S38: Absenteeism and presenteeism in patients with CKD

CKD stage, treatment modality	Absenteeism (Days per year)		Presenteeism (Days per year)	
	Mean	*SD*	*Mean*	*SD*
No CKD	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Stage 3a	17.04	47.76	45.12	47.52
Stage 3b	12.24	35.52	47.04	45.36
Stage 4	19.92	47.76	66.96	53.52
Stage 5	30.24	55.20	51.12	57.36
Stage 5, Transplant	11.04	47.04	36.0	49.92
Stage 5, Hemodialysis	29.28	57.60	83.28	59.28
Stage 5, Peritoneal Dialysis	29.28	57.60	83.28	59.28

Abbreviations: CKD = chronic kidney disease; SD = standard deviation

Source: van Haalen et al., 2020 (50) (Multinational proxy)

Supplemental Table S39: Absenteeism in caregivers of patients with CKD

CKD stage, treatment modality	Absenteeism (Days per year)	
	Mean	***SD***
Stage 1	3.1	18.2
Stage 2	3.1	18.2
Stage 3a	3.1	18.2
Stage 3b	3.1	18.2
Stage 4	27.0	84.6
Stage 5	27.0	84.6
Stage 5, Transplant	11	31
Stage 5, Hemodialysis	104.8	325.1
Stage 5, Peritoneal Dialysis	104.8	325.1

Abbreviations: CKD = chronic kidney disease; SD = standard deviation

Source: Eriksson, 2017 (51) (Nordic proxy)

Supplemental Table S40: Productivity inputs

Input	Value	Source
Cost per workday	CHF 449.16	Federal Statistics Office 2022 (52)
GDP per hour worked	103	OECD 2022 (53)
Percent of absenteeism considered as lost tax revenue	50%	Assumption
Average tax rate for worker	23.4%	OECD 2022 (54)

Abbreviations: CHF = Swiss francs; GDP = gross domestic product; OECD = Organization for Economic Co-operation and Development.

Supplemental Table S41: Data sources used to estimate the environmental impact of CKD across all disease stages and KRT modalities

Parameter	Source
Annual rate of GP visits, stratified by stage	Local Swiss RWD (FIRE project) (3)
Annual rate of specialist visits, stratified by stage	UK proxy used (55)
Annual rate of emergency room visits, stratified by stage	UK proxy used (55)
Annual rate of hospitalisation, and average length of stay, stratified by stage	UK proxy (55) (Swiss data used for length of stay (56))
Proportions of different RRT modalities, including conservative care	ERA Registry Annual Report 2021 (19)
Frequency of dialysis modalities (CAPD/APD/at-home HD, in-centre HD)	Clinical opinion (57)
Proportions of living vs deceased kidney transplant	ERA Registry Annual Report 2021 (19)
Transport distance to healthcare facilities	Switzerland-specific (58,59)
Energy mix	Ecoinvent database (60) (Switzerland-specific)
Heating, cooling, lighting requirements	Switzerland-specific for hospital efficiencies (61) (scaled using UK data)

Supplemental Table S42: CKD stage-specific HCRU and associated environmental impacts used for Switzerland

CKD stage	Input	Unit	Quantity Used	GHG emissions		Freshwater consumption		Fossil fuel depletion	
				GHG emission factor (kg CO_2e/unit)	Total GHG emissions per patient (kg CO_2e)	Freshwater consumption (m^3)	Total freshwater consumption per patient (m^3)	Fossil fuel depletion (kg oil eq.)	Total Fossil fuel depletion per patient (kg oil eq.)
1	GP Visit	per visit	13.00	0.02	0.24	0.00	0.04	0.02	0.32
	Specialist Care Visit	per visit	2.80	0.14	0.39	0.02	0.07	0.19	0.54
	ER visit	per hour	1.20	0.53	0.62	0.02	0.03	0.35	0.41
	Hospitalisation	per bed day	4.78	12.73	60.82	0.53	2.51	8.31	39.69
	ICU stay	per bed day	0.03	37.90	1.25	1.44	0.05	21.00	0.69
	Transport, of which:								
	to GP	return transport (km)	13.00	4.41	57.38	0.01	0.15	1.42	18.43
	to specialist	return transport (km)	2.80	18.24	51.07	0.05	0.13	5.91	16.56
	to ER	return transport (km)	0.30	5.52	1.66	0.02	0.00	1.80	0.54
	to hospital	return transport (km)	0.50	5.24	2.62	0.01	0.01	1.68	0.84
	to ICU	return transport (km)	0.01	5.79	0.06	0.02	0.00	1.91	0.02
	to pick up medication	return transport (km)	12.00	3.79	45.47	0.01	0.12	1.22	14.60
2	GP Visit	per visit	13.00	0.02	0.24	0.00	0.04	0.02	0.32
	Specialist Care Visit	per visit	2.80	0.14	0.39	0.02	0.07	0.19	0.54
	ER visit	per hour	0.72	0.53	0.37	0.02	0.02	0.35	0.24
	Hospitalisation	per bed day	3.14	12.73	39.98	0.53	1.65	8.31	26.09
	ICU stay	per bed day	0.02	37.90	0.68	1.44	0.03	21.00	0.38
	Transport, of which:								
	to GP	return transport (km)	13.00	4.41	57.38	0.01	0.15	1.42	18.43
	to specialist	return transport (km)	2.80	18.24	51.07	0.05	0.13	5.91	16.56
	to ER	return transport (km)	0.30	5.75	1.72	0.02	0.00	1.80	0.54

	to hospital	return transport (km)	0.60	5.32	3.19	0.01	0.01	1.68	1.01
	to ICU	return transport (km)	0.01	6.18	0.06	0.02	0.00	1.91	0.02
	to pick up medication	return transport (km)	12.00	3.79	45.47	0.01	0.12	1.22	14.60
3	GP Visit	per visit	13.00	0.02	0.24	0.00	0.04	0.02	0.32
	Specialist Care Visit	per visit	3.10	0.14	0.44	0.02	0.08	0.19	0.60
	ER visit	per hour	2.40	0.53	1.25	0.02	0.05	0.35	0.82
	Hospitalisation	per bed day	8.60	12.73	109.51	0.53	4.52	8.31	71.47
	ICU stay	per bed day	0.08	37.90	3.18	1.44	0.12	21.00	1.76
	Transport, of which:								
	to GP	return transport (km)	13.00	4.41	57.38	0.01	0.15	1.42	18.43
	to specialist	return transport (km)	3.10	18.24	56.54	0.05	0.15	5.91	18.33
	to ER	return transport (km)	0.50	6.00	3.00	0.02	0.01	1.80	0.90
	to hospital	return transport (km)	0.70	5.42	3.80	0.02	0.01	1.68	1.18
	to ICU	return transport (km)	0.02	6.57	0.13	0.02	0.00	1.91	0.04
	to pick up medication	return transport (km)	12.00	3.79	45.47	0.01	0.12	1.22	14.60
4	GP Visit	per visit	16.00	0.02	0.29	0.00	0.05	0.02	0.40
	Specialist Care Visit	per visit	3.90	0.14	0.55	0.02	0.10	0.19	0.75
	ER visit	per hour	2.40	0.53	1.30	0.02	0.05	0.35	0.85
	Hospitalisation	per bed day	10.50	12.73	133.70	0.53	5.51	8.31	87.26
	ICU stay	per bed day	0.07	37.90	2.49	1.44	0.09	21.00	1.38
	Transport, of which:								
	to GP	return transport (km)	16.00	5.40	86.35	0.01	0.23	1.72	27.59
	to specialist	return transport (km)	3.90	20.41	79.59	0.05	0.20	6.59	25.71
	to ER	return transport (km)	0.60	6.53	3.92	0.02	0.01	2.17	1.30
	to hospital	return transport (km)	1.10	6.10	6.71	0.02	0.02	2.00	2.20
	to ICU	return transport (km)	0.02	6.96	0.14	0.02	0.00	2.33	0.05
	to pick up medication	return transport (km)	12.00	4.63	55.59	0.01	0.15	1.49	17.90
5: SC	GP Visit	per visit	9.00	0.02	0.16	0.00	0.03	0.02	0.22
	Specialist Care Visit	per visit	5.90	0.14	0.83	0.02	0.15	0.19	1.14
	ER visit	per hour	3.60	0.53	1.96	0.02	0.08	0.35	1.28

	Hospitalisation	per bed day	21.40	12.73	272.50	0.53	11.24	8.31	177.83
	ICU stay	per bed day	0.00	37.90	0.00	1.44	0.00	21.00	0.00
	Transport, of which:								
	to GP	return transport (km)	9.00	6.40	57.57	0.02	0.15	2.05	18.47
	to specialist	return transport (km)	5.90	20.78	122.60	0.05	0.31	6.70	39.52
	to ER	return transport (km)	0.70	7.28	5.10	0.02	0.02	2.43	1.70
	to hospital	return transport (km)	2.00	6.85	13.71	0.02	0.04	2.27	4.54
	to ICU	return transport (km)	0.00	7.71	0.00	0.02	0.00	2.60	0.00
	to pick up medication	return transport (km)	12.00	5.49	65.89	0.01	0.18	1.84	22.10
5: CAPD	GP Visit	per visit	9.00	0.02	0.16	0.00	0.03	0.02	0.22
	Specialist Care Visit	per visit	4.00	0.14	0.56	0.02	0.10	0.19	0.77
	ER visit	per hour	3.60	0.53	1.91	0.02	0.08	0.35	1.25
	Hospitalisation	per bed day	21.40	12.73	272.50	0.53	11.24	8.31	177.83
	ICU stay	per bed day	0.22	37.90	8.34	1.44	0.32	21.00	4.62
	CAPD	per day	1460.00	0.84	1229.57	0.04	51.35	0.39	566.36
	Transport, of which:								
	to GP	return transport (km)	9.00	6.05	54.47	0.02	0.14	1.93	17.38
	to specialist	return transport (km)	4.00	20.78	83.12	0.05	0.21	6.70	26.79
	to ER	return transport (km)	0.70	7.06	4.94	0.02	0.01	2.35	1.65
	to hospital	return transport (km)	2.00	6.77	13.55	0.02	0.04	2.23	4.46
	to ICU	return transport (km)	0.06	7.33	0.44	0.02	0.00	2.46	0.15
	to pick up medication	return transport (km)	12.00	5.19	62.34	0.01	0.17	1.67	20.00
5: APD	GP Visit	per visit	9.00	0.02	0.16	0.00	0.03	0.02	0.22
	Specialist Care Visit	per visit	4.00	0.14	0.56	0.02	0.10	0.19	0.77
	ER visit	per hour	3.60	0.53	1.91	0.02	0.08	0.35	1.25
	Hospitalisation	per bed day	21.40	12.73	272.50	0.53	11.24	8.31	177.83
	ICU stay	per bed day	0.22	37.90	8.34	1.44	0.32	21.00	4.62
	APD	per day	1825	1.61	2934.51	0.04	75.76	0.58	1057.65
	Transport, of which:								
	to GP	return transport (km)	9.00	6.05	54.47	0.02	0.14	1.93	17.38

	to specialist	return transport (km)	4.00	20.78	83.12	0.05	0.21	6.70	26.79
	to ER	return transport (km)	0.70	7.06	4.94	0.02	0.01	2.35	1.65
	to hospital	return transport (km)	2.00	6.77	13.55	0.02	0.04	2.23	4.46
	to ICU	return transport (km)	0.06	7.33	0.44	0.02	0.00	2.46	0.15
	to pick up medication	return transport (km)	12.00	5.19	62.34	0.01	0.17	1.67	20.00
5: Home HD	GP Visit	per visit	9.00	0.02	0.16	0.00	0.03	0.02	0.22
	Specialist Care Visit	per visit	4.00	0.14	0.56	0.02	0.10	0.19	0.77
	ER visit	per hour	3.60	0.53	1.91	0.02	0.08	0.35	1.25
	Hospitalisation	per bed day	21.40	12.73	272.50	0.53	11.24	8.31	177.83
	ICU stay	per bed day	0.22	37.90	8.34	1.44	0.32	21.00	4.62
	At-home HD	per day	208	10.82	2251.50	0.40	83.75	5.39	1120.26
	Transport, of which:								
	to GP	return transport (km)	9.00	6.05	54.47	0.02	0.14	1.93	17.38
	to specialist	return transport (km)	4.00	20.78	83.12	0.05	0.21	6.70	26.79
	to ER	return transport (km)	0.70	7.06	4.94	0.02	0.01	2.35	1.65
	to hospital	return transport (km)	2.00	6.77	13.55	0.02	0.04	2.23	4.46
	to ICU	return transport (km)	0.06	7.33	0.44	0.02	0.00	2.46	0.15
	to pick up medication	return transport (km)	12.00	5.19	62.34	0.01	0.17	1.67	20.00
5: In-centre HD	GP Visit	per visit	9.00	0.02	0.16	0.00	0.03	0.02	0.22
	Specialist Care Visit	per visit	4.00	0.14	0.56	0.02	0.10	0.19	0.77
	ER visit	per hour	3.60	0.53	1.91	0.02	0.08	0.35	1.25
	Hospitalisation	per bed day	21.40	12.73	272.50	0.53	11.24	8.31	177.83
	ICU stay	per bed day	0.22	37.90	8.34	1.44	0.32	21.00	4.62
	In-centre HD	per day	156	5.40	842.71	0.46	71.50	4.09	637.70
	Transport, of which:								
	to GP	return transport (km)	9.00	6.05	54.47	0.02	0.14	1.93	17.38
	to specialist	return transport (km)	4.00	20.78	83.12	0.05	0.21	6.70	26.79
	to ER	return transport (km)	0.70	7.06	4.94	0.02	0.01	2.35	1.65
	to hospital	return transport (km)	2.00	6.77	13.55	0.02	0.04	2.23	4.46
	to ICU	return transport (km)	0.06	7.33	0.44	0.02	0.00	2.46	0.15

	to pick up medication	return transport (km)	12.00	5.19	62.34	0.01	0.17	1.67	20.00
	to HD	return transport (km)	156.00	8.33	1299.48	0.02	3.26	2.63	410.28
5: Peritransplant	GP Visit	per visit	9.00	0.02	0.16	0.00	0.03	0.02	0.22
	Specialist Care Visit	per visit	40.00	0.14	5.64	0.02	0.98	0.19	7.72
	ER visit	per hour	3.60	0.53	1.85	0.02	0.08	0.35	1.20
	Hospitalisation	per bed day	21.10	12.73	268.68	0.53	11.08	8.31	175.34
	ICU stay	per bed day	0.48	37.90	18.34	1.44	0.70	21.00	10.16
	Transplant (living donor)*	per transplant	0.322	206.15	66.38	14.20	4.57	119.00	38.32
	Transplant (deceased donor)	per transplant	0.677	297.15	201.17	14.20	9.61	147.00	99.52
	In-centre HD	per session	21	5.58	117.18	0.46	9.66	4.12	86.52
	Transport, of which:								
	to GP	return transport (km)	9.00	6.05	54.47	0.02	0.14	1.93	17.38
	to specialist	return transport (km)	40.00	20.78	831.22	0.05	2.13	6.70	267.90
	to ER	return transport (km)	0.70	7.06	4.94	0.02	0.01	2.35	1.65
	to hospital	return transport (km)	2.00	6.77	13.55	0.02	0.04	2.23	4.46
	to ICU	return transport (km)	0.05	7.33	0.37	0.02	0.00	2.46	0.12
	to pick up medication	return transport (km)	12.00	5.19	62.34	0.01	0.17	1.67	20.00
5: Prevalent transplant	GP Visit	per visit	9.00	0.02	0.16	0.00	0.03	0.02	0.22
	Specialist Care Visit	per visit	4.00	0.14	0.56	0.02	0.10	0.19	0.77
	ER visit	per hour	3.60	0.53	1.91	0.02	0.08	0.35	1.25
	Hospitalisation	per bed day	21.30	12.73	271.22	0.53	11.18	8.31	177.00
	ICU stay	per bed day	0.11	37.90	4.21	1.44	0.16	21.00	2.33
	Transport, of which:								
	to GP	return transport (km)	9.00	6.05	54.47	0.02	0.14	1.93	17.38
	to specialist	return transport (km)	4.00	20.78	83.12	0.05	0.21	6.70	26.79
	to ER	return transport (km)	0.70	7.06	4.94	0.02	0.01	2.35	1.65
	to hospital	return transport (km)	2.00	6.77	13.55	0.02	0.04	2.23	4.46
	to ICU	return transport (km)	0.03	7.33	0.22	0.02	0.00	2.46	0.07
	to pick up medication	return transport (km)	12.00	5.19	62.34	0.01	0.17	1.67	20.00

*Transplant (living donor) module includes scans, hospital stays, donor and recipient surgery (including anaesthetics), and patient transport. Deceased donor module additionally includes Marshall's hypertonic citrate for organ transportation.

APD, automated peritoneal dialysis; CAPD, continuous ambulatory peritoneal dialysis; CO_2e, carbon dioxide equivalents; GP, general practitioner; ER, emergency room; HD, haemodialysis; ICU, intensive care unit; SC, supportive care.

Supplemental Table S43: Annual per patient environmental burden associated with CKD

Condition	Climate change, default, excl. biogenic carbon [kg CO_2 eq.]	Freshwater Consumption [m^3]	Fossil depletion [kg oil eq.]
Stage 1	222	3.11	92.6
Stage 2	201	2.22	78.7
Stage 3a	281	5.25	128
Stage 3b	281	5.25	128
Stage 4	371	6.42	165
Stage 5	540	12.2	266
Transplant	497	12.1	252
Transplant Maintenance	1650	39.2	731
Hemodialysis	2700	91.6	1340
Peritoneal Dialysis	2580	75.9	1070

Abbreviations: CKD = chronic kidney disease; CO_2 = carbon dioxide; eq. = equivalent.
Source: Maverex Data on File, 2024 (62)

Validation Targets and Outputs

Supplemental Table S44: Targets and model output for model external validation

Parameter	Validation Target	Model Output	Target reference
Baseline characteristics			
% Female in Total Population[a]	50.31%	50.32%	Federal Statistical Office, 2022 (1)
Average age of Total Population (years)[a]	42.2	42.62	
RRT at baseline			
Prevalence of transplants at baseline (per million)	503	507	ERA-EDTA Registry, 2019 (2)
Prevalence of dialysis at baseline (per million)	433	442	
AKI			
Average AKI events/year in population (CKD and non-CKD) (per million)	5,300-20,700	18,782	UK Kidney Association, 2020 (63)
CV Events			
Average Stroke events/year in population (per million)	1,055	1,023	Stroke Alliance for Europe, 2017 (64) (Germany; 89,464 total)
Average MIs/year in population (per million)	2,183	2,328	Federal Statistical Office 2019 (65)
Average HHF/year in population (per million)	2,591	2,446	
Mortality			
10-year average annual mortality (CKD and non-CKD)	0.81%	0.88%	Federal Statistical Office, 2023 (1)

[a]Calculated from population data.

Abbreviation: AKI = acute kidney injury; CKD = chronic kidney disease CV = cardiovascular; eGFR = estimated glomerular filtration rate; HHF = hypertensive heart failure; MI = myocardial infarction; RRT = renal replacement therapy.

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