FRESHER PROJECT

Cost-of-Illness Analysis for the NETHERLANDS

Technical Report

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For referencing in other related report, this report can be called « Thiébaut, 2017b »

Contents

General Overview

- In 2013, health care (HC) expenditure amounted to 12.9% of GDP in the Netherlands. Out-of-pocket payments are low from an international perspective, representing 9% of health expenditures (WHO, 2016).

- In the Netherlands population is covered by a mandatory private insurance system and the main private insurer, VEKTIS, is in charge to collect all discharge data from every Dutch insurer.

- The COI analysis was performed on Dutch reimbursement cost database (Vektis) for year 2013.

- This sample contained **13,4 millions individuals** aged 18 and over. People in nursing home are not included in this sample.

- A mandatory deductible is paid out-of-pocket by Dutch citizen. This cost component, not included in discharge data, was corrected for at individual level according to age and gender.

- Diseases were identified at individual level according to Atomical Therapeutic Chemical (ATC) codes recorded in 2013 for each Dutch insured citizen who had a consumption of prescribed medicines over the year. If medicines were delivered at hospitals and nursing homes then ATC code is not recorded.

- This leads to disease identification difficulties for some illnesses namelly Chronic Kidney Disease (CKD), Cirrhosis and Cancer.

Health Care System in the Netherlands

A private health care system regulated by the Government

Since the Health Insurance Act (Zvw), the major Dutch health insurance reform of 2006, citizens in the Netherlands are covered by a mandatory private insurance system while public insurance no longer exists. The government continues to play a regulation role and subsidizes premiums for low-income people. The healthcare sector is mainly financed by compulsory contributions and premiums while out-of-pocket payments are the lowest in Europe.

The HC sector is divided into three markets:

- Health insurance : health insurers offer a basic insurance package, which is obligatory for all citizens. Patient can choose the insurer of their choice, and pay premiums to their insurer. The basic benefits package includes GP care, maternity care, hospital care, nursing care, pharmaceutical care and mental healthcare.
- Health services provision : health insurers negotiate with providers.
- Healthcare purchasing : patients elect their care providers.

Important for COI analysis: The main insurer, VEKTIS, is in charge of collecting all discharge data from every insurer of the country. This confers to our sample a full representativity of Dutch community dwellers, but excludes persons in nursing homes.

Mandatory deductible

The first €350 (in 2013) must be paid out-of-pocket, except for GP consultations, maternity care, nursing care and care for children under 18 years. In 2010, this totalled about €1.4 billion (van Ewijk, van der Horst & Besseling, 2013) or 2 percentage points of total OOP (2 points of the 9%).

Important for COI analysis: This deductible does not appear in discharge data, so a correction was applied on cost vector to take it into account.

Comparativeness of health care systems

Organization of care provision is as follow :

- Healthcare providers are independent non-profit entrepreneurs.
- Hospitals are paid through diagnosis-related group (DRG) system
- GPs are paid by a combination of fee-for-service, capitation, bundled payments for integrated care, and pay-for-performance. They have a gatekeeping function.
- Dutch medical specialists work independently within the hospital organization for both inpatient and outpatient care. Most are formally self-employed and are contracted to one of the hospitals.

Important for COI analysis: While the Dutch insurance system is completly diffrent from systems found in France and in Estonia (private versus public), the organization of care provision is quite similar in all three countries, appart for specialist care.

Data characteristics and population representativity

The cost-of-illness analysis for the Netherlands was based on following sets of data ; corresponding population sizes are presented in Table 1.

- GBAPERSOONTAB (Zvw-insured GBA dataset)
- ZVWKOSTENTAB (VEKTIS dataset)
- MEDICIJNTAB (ATC codes dataset)

GBAPERSOONTAB

This set of data contains all insured individuals and their invariant characteristics, such as date of birth and gender. This file was used as a census dataset. It allows to know who were users of HC, at least for the younger age groups not living in nursing home.

ZVWKOSTENTAB

This file contains costs per year and for each care type, for every Dutch resident who is insured via the basic insurance. The basic insurance is legally required through the Health Insurance Act (Zvw) for almost all Dutch residents. The costs are those costs actually reimbursed by the health insurers.
If the deductible is not reached, the costs are not included.

Data on actual reimbursed costs come from Vektis, which collects data received from the health insurance companies. The costs is incurred during the year itself and in the 3 observed subsequent quarters, then during the year itself and thereafter for 4 next quarters. After 8 quarters of observation the file contains about 98% of all declarations. The health insurers have estimate of the remaining costs that they still expect to receive. Using this estimate, Vektis increases the costs per health insurer and per care type; these increased costs are included in this file. The actual costs are not available separately. An important point for attention is that costs are increased only for those who already had costs. It is therefore not possible to fully determine the exact number of HC users.
However, working on 2013 data allow us to observe 98% of HC users. But people receiving care in nursing homes are not included.

The health insurers can be divided into risk carriers and proxy holders. The risk carriers are the "real" health insurers and carry the financial risk associated with insuring a person. The proxy holders do close basic insurance policies, but they do this on behalf of one or more risk bearers. Proxy holders do not bear the risk themselves. The proxy holders are aware that the cost data they report is not reliable. They provide identifying data of people, making it possible to identify the population that is insured through them. Then it is possible to omit this subpopulation of insured.
This is done by Vektis and the resulting increment factors are in the variable ZVWOPHOOGFACTOR. All model estimates were done on weighted population. Before proceeding with publication, permission is required from Vektis and the increment factor should be used when working on the whole insured population.

MEDICIJNTAB

This file contains data on patients who were delivered prescribed medicines during the year and subject to reimbursement within the basic insurance package. The population includes everybody registered in the GBA file but medicines received at hospitals and nursing homes are not recorded. Dispensed medicines are classified into Anatomical Therapeutic Chemical (ATC) classes, according to WHO drug classification system. Data are aggregated per person to medicine groups on 4 digits ATC-code.

Table 1: Population size in raw datasets

	18+ in COST DATA (ZVWKOSTENTAB)		18+ in ATC CODES DATA (MEDICIJNTAB)		18+ in Census DATA (GBAPERSOONTAB)	
AGE	**MALE**	**FEMALE**	**MALE**	**FEMALE**	**MALE**	**FEMALE**
18-39	2 124 554	2 109 961	1 024 915	1 547 826	2 500 351	2 445 737
40-49	1 358 296	1 356 736	812 575	997 351	1 611 506	1 523 931
50-59	1 189 314	1 189 756	834 957	942 342	1 368 022	1 301 420
60-64	524 677	523 479	418 945	437 677	605 147	578 597
65-69	494 855	501 019	417 598	434 929	594 220	565 699
70-74	339 157	361 608	302 122	327 371	442 506	424 760
75-79	247 533	295 551	228 269	274 100	374 368	374 301
80-84	165 297	240 308	153 572	221 233	333 265	357 710
85-89	84 982	162 477	77 813	144 123	278 213	334 191
90+	35 552	103 429	31 383	85 599	479 896	821 646
TOTAL	6 564 217	6 844 324	4 302 149	5 412 551	8 587 494	8 727 992
		13 408 541		9 714 700		17 315 486

Method

Econometric stratégy

Statistical analysis performed for COI estimates for the Netherlands follows the methods described in report by Cortaredona and Ventelou (2017), Goryakin (2017) and Thiébaut (2017a). However some adjustments were made according to the nature of the data.

First part : the probability to have a positive spending

The probability to have a positive expense is necessary to correctly estimate average cost just like zeros have to be accounted for when one wants to compute an arithmetic mean. Asymptotically the probability to have a positive consumption converges towards the proportion of HC users.

- **Issue for last age classes**

In this respect, an issue arises in the case of COI for Netherlands from the fact that observation rate for the last age classes is biased in cost and medication datasets because people in nursing homes are not included. Consequently, probability can not be estimated for people living in institution. Only a probability to observe the cost (i.e. : smoothed observation rate) can be computed. For these age groups, probability etsimated for France or for Estonia should be used. Table 1 highlights the most critical age classes.

- **Artificial population**

In the same spirit as for COI for Estonia (see Thiébaut, 2017a), an artificial population is derived from comparison between number of people in cost sample and and number of people in census (GBA population). As noted in data description section, the « true » population to be considered for cost estimates is the weighted population. So artificial population arises from the diffrence between the GBA population and the sum of ZVWOPHOOGFACTOR variable (the weight variable built by Vektis), by age and gender, as described in Table 2.

Table 2: Artificial population for first part estimates

Age Group	Gender	Cost dataset population size	Sum of Zvwophoogfactor (weighted population)	Census Population (GBA)	Artificial Population for first part estimates (census minus weighted population)
18-39	male	2 124 554	2 128 668	2 500 351	371 683
40-49	male	1 358 296	1 362 463	1 611 506	249 043
50-59	male	1 189 314	1 193 343	1 368 022	174 679
60-64	male	524 677	526 312	605 147	78 835
65-69	male	494 855	495 471	594 220	98 749
70-74	male	339 157	339 448	442 506	103 058
75-79	male	247 533	247 686	374 368	126 682
80-84	male	165 297	165 397	333 265	167 869
18-39	female	2 109 961	2 112 786	2 445 737	332 951
40-49	female	1 356 736	1 359 580	1 523 931	164 351
50-59	female	1 189 756	1 192 327	1 301 420	109 093
60-64	female	523 479	524 608	578 597	53 989
65-69	female	501 019	501 277	565 699	64 422
70-74	female	361 608	361 770	424 760	62 990
75-79	female	295 551	295 682	374 301	78 619
80-84	female	240 308	240 422	357 710	117 288

Mandatory deductible

The mandatory deductible is not included in discharge dataset but we know it represents 2% of health care cost (WHO, 2016). An implicit average deductible was computed by age and gender to inflat the observed individual spendings. Those additional average cost is presented in Table 3. Note that only this OOP component was corrected for, remaining 7% OOP were not considered because hardly identifiable and estimable (conservative approach).

Table 3: Correction for mandatory deductible

Sum of Cost in Euros (weighted population)		Sum of Zvwophoogfactor (weighted population)		Total OOP mandatory deductible in Euros (= cost * (0.02/0.91))		Individual Expenditure correction in Euros	
Male	Female	Male	Female	Male	Female	Male	Female
3 158 587 881	5 293 148 751	2 128 668	2 112 786	69 419 514	116 332 940	33	55
2 557 791 729	3 062 790 478	1 362 463	1 359 580	56 215 203	67 314 076	41	50
3 063 033 727	3 313 733 044	1 193 343	1 192 327	67 319 423	72 829 298	56	61
1 797 885 154	1 693 453 238	526 312	524 608	39 513 959	37 218 752	75	71
2 034 718 182	1 882 965 807	495 471	501 277	44 719 081	41 383 864	90	83
1 714 435 707	1 604 659 187	339 448	361 770	37 679 906	35 267 235	111	97
1 488 582 254	1 514 396 113	247 686	295 682	32 716 093	33 283 431	132	113
1 081 580 173	1 317 673 421	165 397	240 422	23 770 993	28 959 855	144	120

Disease identification

Identification of NCDs was only possible on the basis of ATC codes of medications prescribed to patients, outside hospital (limitation of dataset as describe in corresponding section). Thus identification of cancer was hardly possible because medications (antineoplastic agent) are almost always delivered at hospital.

On the one hand a literature review was perfomed to list the accurate ATC codes for each disease classification. This review highlited first the impossibility to identify Chronic Kidney Disease (CKD) and cirrhosis. Diabetes and Alcohol use disorder were identified directly by molecules identified into this literature.

Three papers were identified :

- Lamers, René C.J.A. van Vliet, The Pharmacy-based Cost Group model: validating and adjusting the classification of medications for chronic conditions to the Dutch situation, In Health Policy, Volume 68, Issue 1, 2004, Pages 113-121.
- Huber CA, Szucs TD, Rapold R, et al. Identifying patients with chronic condi- tions using pharmacy data in Switzerland: an updated mapping approach to the classification of medications. BMC Public Health 2013; 13: 1030.
- Dong YH, Chang CH, Shau WY, et al. Development and validation of a pharmacy-based comorbidity measure in a population-based automated health care database. Pharmacotherapy 2013; 33: 126–136.

On the other hand stroke, heart disease, COPD, depression and neurologic disorders were identified by computing a likelyhood score based on a weighted sum of ATC codes. The weights were estimated via a random forest analysis and provided by our partners at National Institute for Public Health and the Environment (RIVM) (see forcoming working paper by Lany Slobbe and Marc Koopmanschap for more details).

Results

Prevalence

Table 4: Identified Number of Cases for each NCD

AGEcat	SEX	STROKE	HD	CANCER	DIABETES	COPD	AUD	DEPRESSION	NEURODISO
18-39	male	972	10 082	2 071	14 120	41 834	5 750	94 508	0
40-49	male	1 626	31 289	2 803	36 878	58 840	9 436	33 184	529
50-59	male	4 880	76 812	5 421	77 862	113 388	9 329	34 280	2 715
60-64	male	1 373	57 456	4 471	57 453	83 547	3 416	14 119	2 543
65-69	male	2 404	87 764	6 259	70 545	97 576	2 169	11 273	5 668
70-74	male	2 851	84 508	5 881	58 131	88 109	1 065	8 752	6 484
75-79	male	3 527	88 827	5 075	45 439	92 263	473	7 643	15 477
80-84	male	3 164	92 518	3 450	30 660	83 915	180	13 187	26 656
18-39	female	725	6 273	3 341	15 061	18 913	4 137	146 866	0
40-49	female	2 740	13 247	4 609	28 981	34 364	6 416	51 676	643
50-59	female	3 746	29 010	7 453	59 037	69 165	7 645	55 263	2 908
60-64	female	2 786	21 321	4 692	42 494	45 640	2 661	22 782	2 473
65-69	female	3 714	36 027	6 137	53 861	57 979	1 819	21 038	6 289
70-74	female	2 006	36 511	5 346	50 478	53 913	826	17 042	10 411
75-79	female	2 818	46 830	4 397	48 747	53 756	406	16 631	17 221
80-84	female	3 255	56 168	3 195	41 779	54 177	191	15 465	52 730
TOTAL		42 587	774 643	74 601	731 526	1 047 379	55 919	563 709	152 747

Table 5: NCDs Prevalences

AGEcat	SEX	STROKE	HD	CANCER	DIABETES	COPD	AUD	DEPRESSION	NEURODISO
18-39	male	0,04%	0,40%	0,08%	0,56%	1,67%	0,23%	3,78%	0,00%
40-49	male	0,10%	1,94%	0,17%	2,29%	3,65%	0,59%	2,06%	0,03%
50-59	male	0,36%	5,61%	0,40%	5,69%	8,29%	0,68%	2,51%	0,20%
60-64	male	0,23%	9,49%	0,74%	9,49%	13,81%	0,56%	2,33%	0,42%
65-69	male	0,40%	14,77%	1,05%	11,87%	16,42%	0,37%	1,90%	0,95%
70-74	male	0,64%	19,10%	1,33%	13,14%	19,91%	0,24%	1,98%	1,47%
75-79	male	0,94%	23,73%	1,36%	12,14%	24,65%	0,13%	2,04%	4,13%
80-84	male	0,95%	27,76%	1,04%	9,20%	25,18%	0,05%	3,96%	8,00%
18-39	female	0,03%	0,26%	0,14%	0,62%	0,77%	0,17%	6,00%	0,00%
40-49	female	0,18%	0,87%	0,30%	1,90%	2,25%	0,42%	3,39%	0,04%
50-59	female	0,29%	2,23%	0,57%	4,54%	5,31%	0,59%	4,25%	0,22%
60-64	female	0,48%	3,68%	0,81%	7,34%	7,89%	0,46%	3,94%	0,43%
65-69	female	0,66%	6,37%	1,08%	9,52%	10,25%	0,32%	3,72%	1,11%
70-74	female	0,47%	8,60%	1,26%	11,88%	12,69%	0,19%	4,01%	2,45%
75-79	female	0,75%	12,51%	1,17%	13,02%	14,36%	0,11%	4,44%	4,60%
80-84	female	0,91%	15,70%	0,89%	11,68%	15,15%	0,05%	4,32%	14,74%

Cost

Table 6: Arithmetic Mean, Standard deviation and Sum of Reimbursed cost for overall population

		Reimbursed Cost			Reimbursed Cost + mandatory deductible		
SEX	AGEcat	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM
male	18-39	1 263	8 564	3 158 587 881	1 289	8 565	3 222 447 911
male	40-49	1 587	8 581	2 557 791 729	1 619	8 582	2 609 565 338
male	50-59	2 239	9 299	3 063 033 727	2 284	9 301	3 125 087 560
male	60-64	2 971	10 371	1 797 885 154	3 031	10 374	1 834 200 699
male	65-69	3 424	10 573	2 034 718 182	3 494	10 578	2 076 337 719
male	70-74	3 874	10 550	1 714 435 707	3 953	10 559	1 749 398 833
male	75-79	3 976	10 220	1 488 582 254	4 058	10 237	1 519 047 670
male	80-84	3 245	8 901	1 081 580 173	3 312	8 926	1 103 743 302
female	18-39	2 164	8 132	5 293 148 751	2 208	8 134	5 400 900 819
female	40-49	2 010	7 978	3 062 790 478	2 051	7 979	3 125 331 167
female	50-59	2 546	8 788	3 313 733 044	2 598	8 789	3 381 695 676
female	60-64	2 927	9 171	1 693 453 238	2 987	9 173	1 728 077 387
female	65-69	3 329	9 570	1 882 965 807	3 396	9 573	1 921 062 872
female	70-74	3 778	9 760	1 604 659 187	3 855	9 766	1 637 580 241
female	75-79	4 046	9 684	1 514 396 113	4 129	9 693	1 545 442 738
female	80-84	3 684	8 612	1 317 673 421	3 760	8 628	1 344 841 111

Table 7: Arithmetic Mean, Standard deviation and Sum of Reimbursed cost for people with at least one FRESHER-modelled NCD

		Reimbursed Cost			Reimbursed Cost + mandatory deductible		
SEX	AGEcat	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM
male	18-39	8 194	25 583	1 282 438 404	8 224	25 583	1 287 133 401
male	40-49	6 702	19 218	991 547 743	6 740	19 218	997 169 875
male	50-59	6 309	15 996	1 610 118 566	6 361	15 996	1 623 389 483
male	60-64	6 585	15 631	1 115 016 453	6 654	15 631	1 126 700 009
male	65-69	7 035	14 943	1 407 994 603	7 119	14 943	1 424 805 751
male	70-74	7 692	14 620	1 294 524 747	7 795	14 620	1 311 859 353
male	75-79	7 969	13 699	1 232 964 720	8 092	13 699	1 251 994 431
male	80-84	7 647	12 613	999 495 273	7 781	12 613	1 017 009 689
female	18-39	8 596	23 156	1 588 155 304	8 647	23 156	1 597 578 188
female	40-49	8 378	19 562	1 019 312 463	8 424	19 562	1 024 909 302
female	50-59	7 623	16 592	1 434 440 051	7 680	16 592	1 445 165 913
female	60-64	7 282	15 640	822 753 288	7 348	15 640	830 210 273
female	65-69	7 430	15 058	1 033 842 339	7 506	15 058	1 044 417 966
female	70-74	7 528	13 931	959 335 238	7 619	13 931	970 931 520
female	75-79	7 871	13 535	1 003 832 893	7 976	13 535	1 017 223 665
female	80-84	7 473	11 598	1 004 426 887	7 586	11 598	1 019 614 419

Table 8: Arithmetic Mean, Standard deviation and Sum of Reimbursed cost for people without any NCD

		Reimbursed Cost			Reimbursed Cost + mandatory deductible		
SEX	AGEcat	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM
male	18-39	435	5 032	651 125 834	457	5 032	684 917 019
male	40-49	440	4 792	364 609 069	467	4 793	386 636 967
male	50-59	453	5 032	247 500 570	488	5 033	266 845 475
male	60-64	445	4 597	84 953 693	485	4 600	92 687 005
male	65-69	405	4 602	73 169 449	443	4 606	80 045 783
male	70-74	302	3 134	43 173 014	331	3 142	47 261 480
male	75-79	192	2 495	28 396 944	210	2 503	30 990 102
male	80-84	113	1 793	20 447 048	123	1 801	22 118 608
female	18-39	724	4 030	661 327 574	757	4 034	690 913 766
female	40-49	482	3 803	267 673 454	514	3 805	285 667 307
female	50-59	480	3 970	181 997 056	521	3 972	197 389 607
female	60-64	470	4 206	69 464 025	512	4 209	75 652 141
female	65-69	439	4 342	59 844 720	479	4 345	65 307 576
female	70-74	408	4 746	40 799 754	441	4 751	44 172 701
female	75-79	311	3 929	31 686 634	335	3 936	34 136 265
female	80-84	203	2 458	27 919 390	220	2 467	30 203 208

Table 9: Arithmetic Mean, Standard deviation and Sum of Reimbursed cost for people without FRESHER-modelled NCD

		Reimbursed Cost			Reimbursed Cost + mandatory deductible		
SEX	AGEcat	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM	WEIGHTED MEAN	WEIGHTED SD	WEIGHTED SUM
male	18-39	800	5 578	1 876 149 477	826	5 579	1 935 314 510
male	40-49	1 070	6 390	1 566 243 986	1 102	6 391	1 612 395 464
male	50-59	1 306	6 554	1 452 915 161	1 349	6 556	1 501 698 077
male	60-64	1 567	6 883	682 868 701	1 623	6 886	707 500 689
male	65-69	1 590	6 722	626 723 579	1 653	6 727	651 531 969
male	70-74	1 531	5 831	419 910 960	1 596	5 842	437 539 481
male	75-79	1 164	5 168	255 617 535	1 216	5 184	267 053 239
male	80-84	405	2 670	82 084 900	428	2 687	86 733 613
female	18-39	1 639	4 906	3 704 993 446	1 682	4 908	3 803 322 631
female	40-49	1 457	5 669	2 043 478 015	1 498	5 670	2 100 421 865
female	50-59	1 688	6 217	1 879 292 994	1 740	6 218	1 936 529 763
female	60-64	1 870	6 281	870 699 950	1 928	6 283	897 867 115
female	65-69	1 991	6 342	849 123 468	2 055	6 345	876 644 906
female	70-74	2 170	6 656	645 323 949	2 242	6 663	666 648 720
female	75-79	2 069	6 007	510 563 221	2 141	6 018	528 219 074
female	80-84	1 403	4 897	313 246 534	1 456	4 915	325 226 693