SHARE project

Sustainable Healthcare Resource Allocation in Scarcity via Robotic Surgery Evaluation

ANESTHESIOLOGY
safe - comfortable - high quality - sustainable

Elke Bos – Anesthesiologist Amsterdam UMC

Amsterdam Research Centre for Health Economics

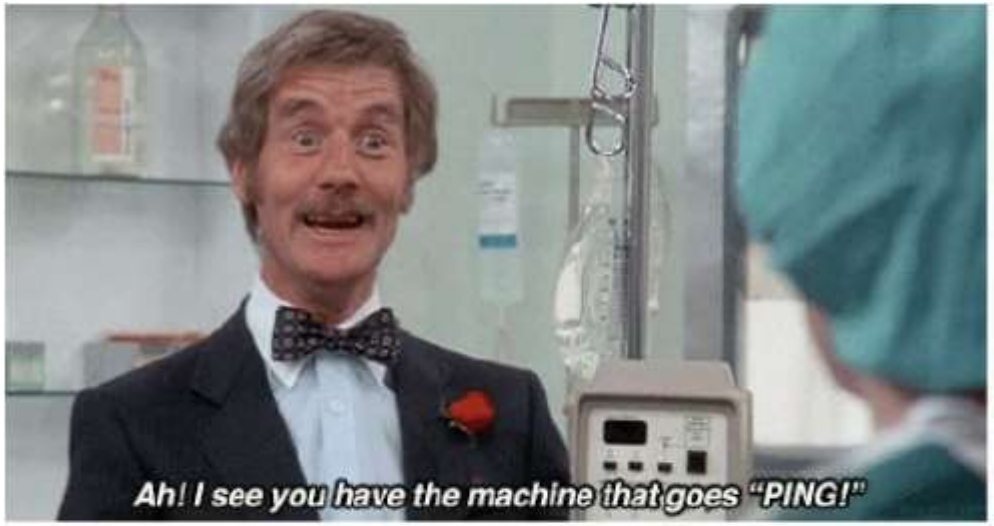
Amsterdam UMC
Universitair Medische Centra

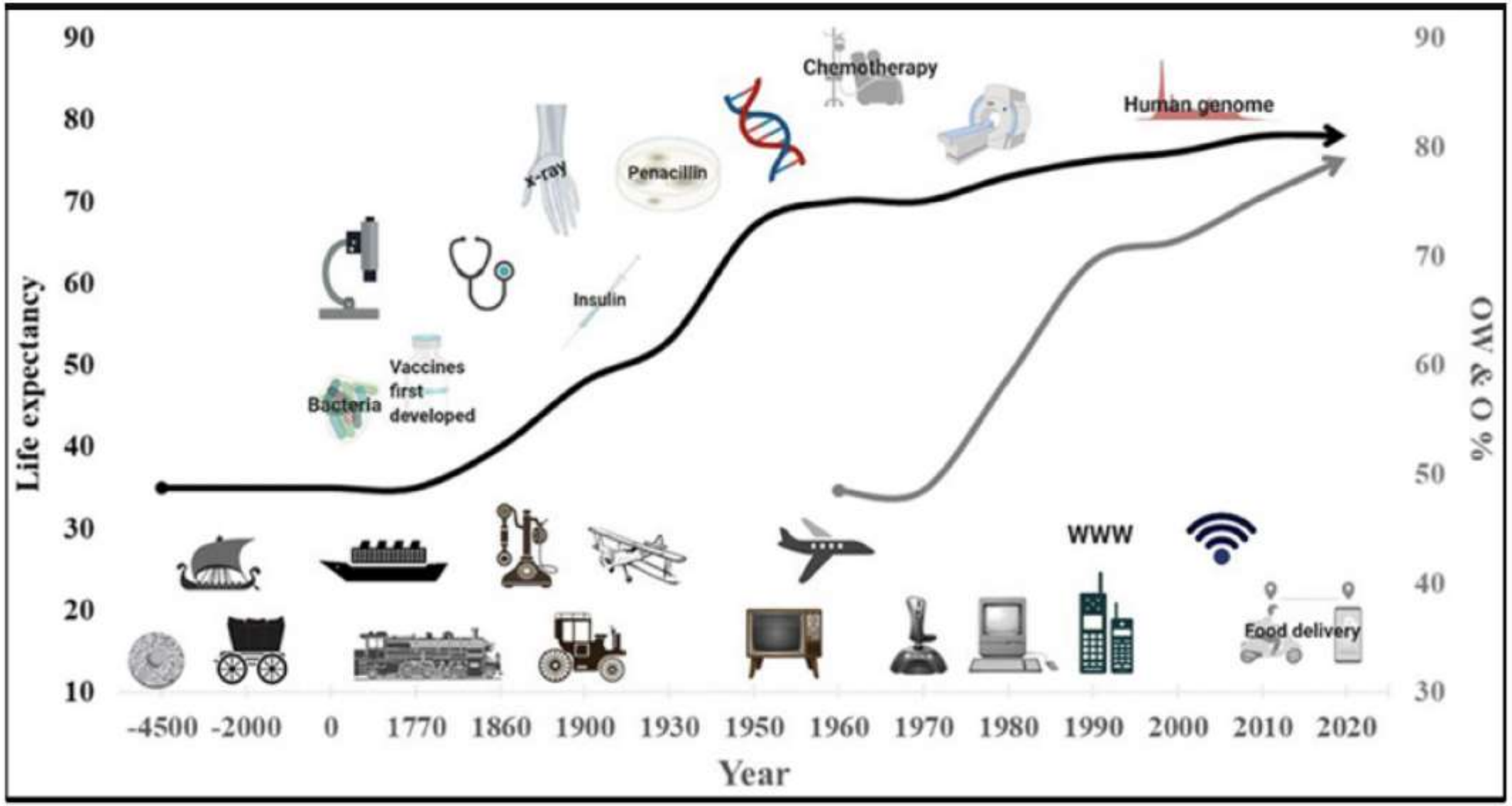
Centrum voor Duurzame Zorg Amsterdam UMC

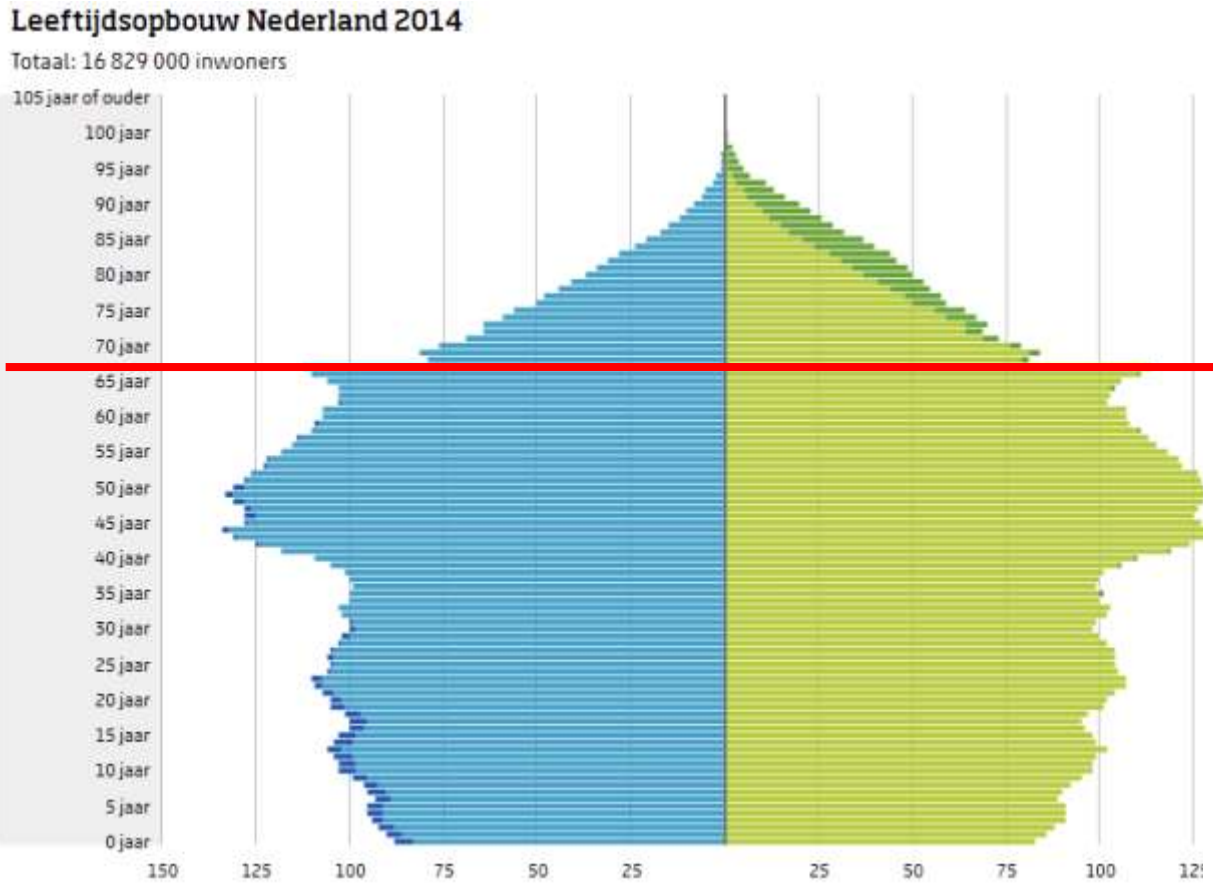
VU VRIJE UNIVERSITEIT AMSTERDAM

seo economisch onderzoek
de wetenschap dat het goed is

ZE&GG Zorgevaluatie & Gepast Gebruik


Ah! I see you have the machine that goes "PING!"


Life expectancy
OW & O %
Year
90
80
70
60
50
40
30
20
10
-4500
-2000
0
1770
1860
1900
1930
1950
1960
1970
1980
1990
2000
2010
2020
Chemotherapy
Human genome
X-ray
Penacillin
Insulin
Vaccines first developed
Bacteria
WWW
Food delivery


Leeftijdsopbouw Nederland 2014
Totaal: 16 829 000 inwoners
105 jaar of ouder
100 jaar
95 jaar
90 jaar
85 jaar
80 jaar
75 jaar
70 jaar
65 jaar
60 jaar
55 jaar
50 jaar
45 jaar
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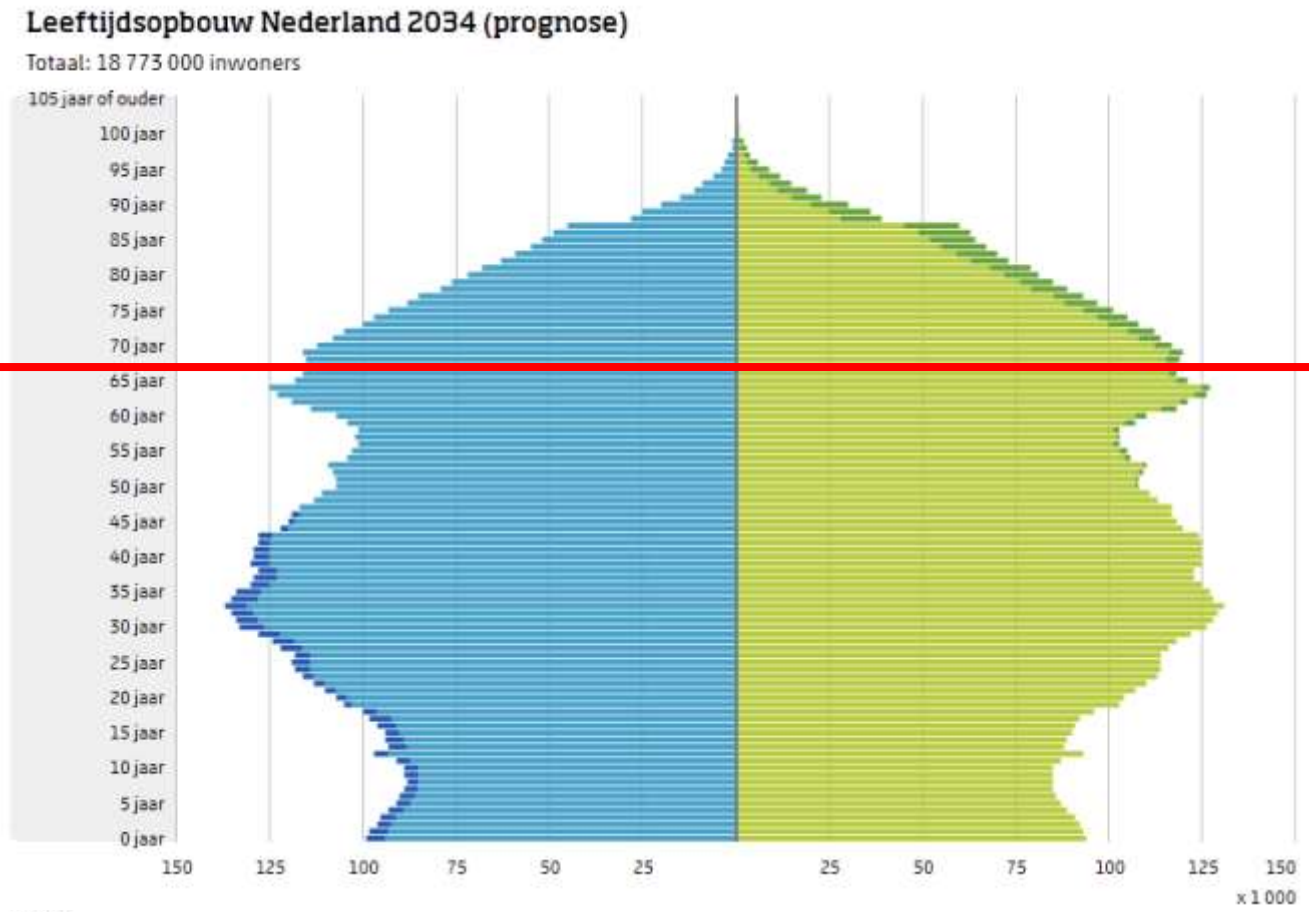
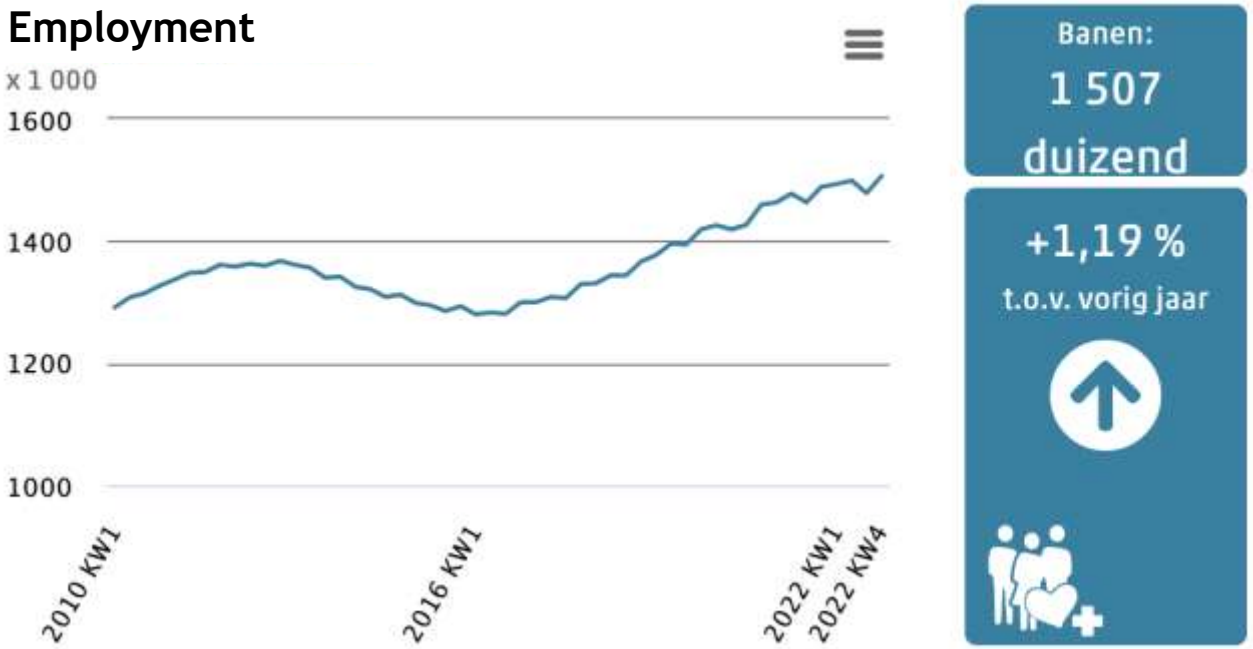
5 jaar
0 jaar
150 125 100 75 50 25 25 50 75 100

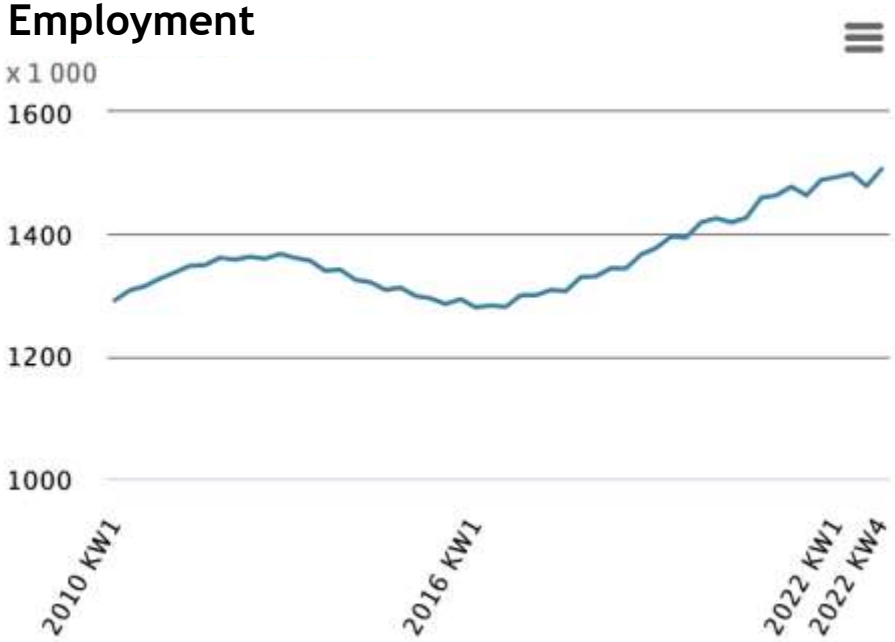

Leeftijdsopbouw Nederland 2034 (prognose)
Totaal: 18 773 000 inwoners
105 jaar of ouder
100 jaar
95 jaar
90 jaar
85 jaar
80 jaar
75 jaar
70 jaar
65 jaar
60 jaar
55 jaar
50 jaar
45 jaar
40 jaar
35 jaar
30 jaar
25 jaar
20 jaar
15 jaar
10 jaar
5 jaar
0 jaar
150 125 100 75 50 25 25 50 75 100 125 150
x 1 000

"I'm not going to be a victim of my own success."

Employment


x 1 000
1600
1400
1200
1000
2010 KW1
2016 KW1
2022 KW1
2022 KW4
Banen:
1 507
duizend
+1,19 %
t.o.v. vorig jaar

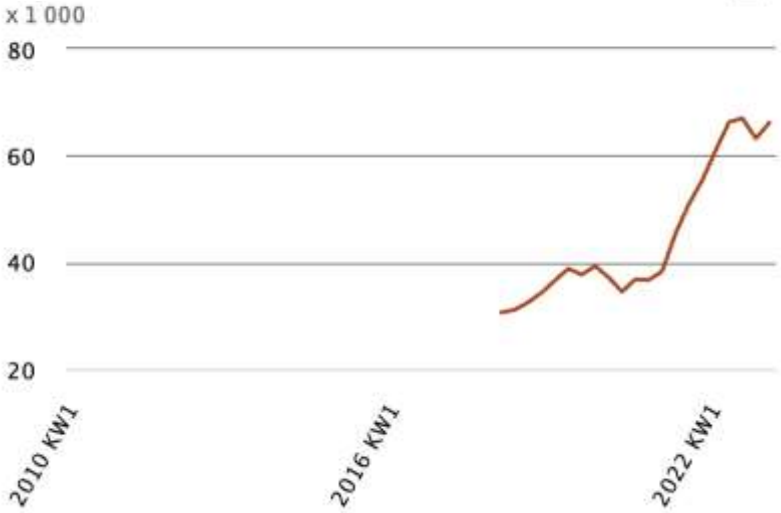
Employment



Banen:
1 507
duizend

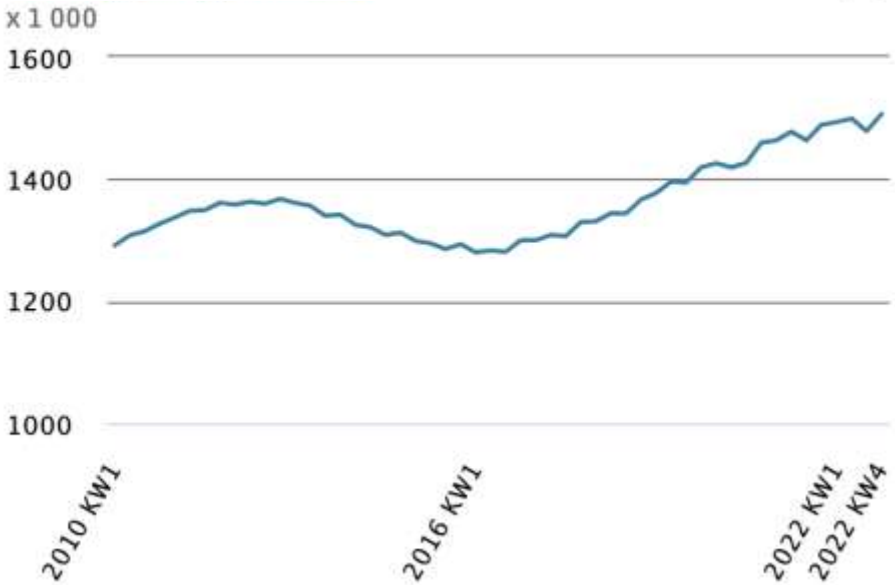
+1,19 %
t.o.v. vorig jaar

Open positions



Openstaande vacatures:
66,2
duizend
+8.5 %
t.o.v. vorig jaar

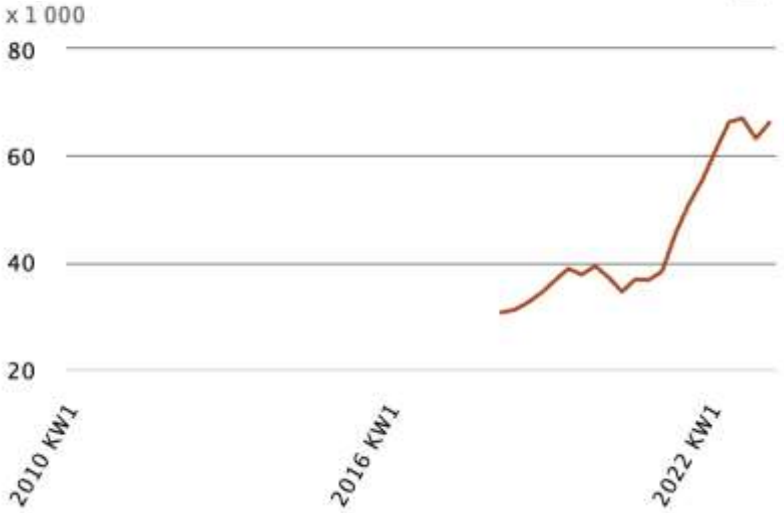
Employment



Banen:
1 507
duizend

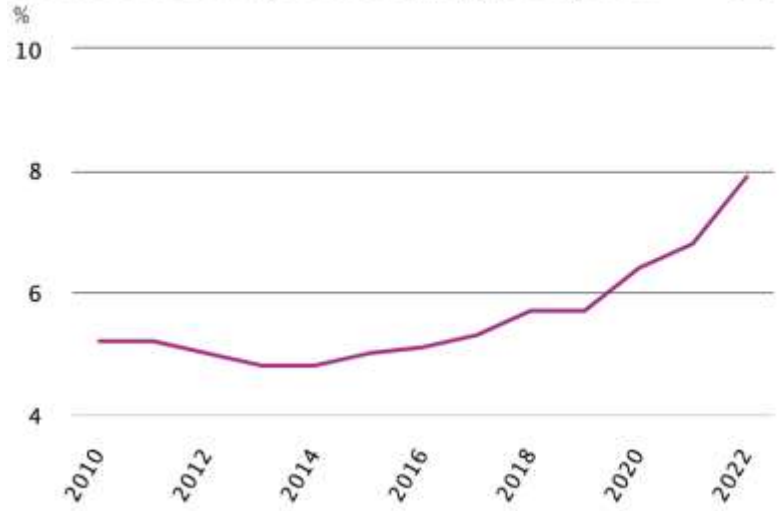
+1,19 %
t.o.v. vorig jaar

Open positions



Openstaande vacatures:
66,2
duizend
+8.5 %
t.o.v. vorig jaar

Absenteeism due to illness



Ziekteverzuimperce jaarcijfers:
7,9%

+1,1 %-punt
t.o.v. vorig jaar


UCAN
ECMO
HELMSLEY
Medische innovatie
Innovaties in de gezondheidszorg

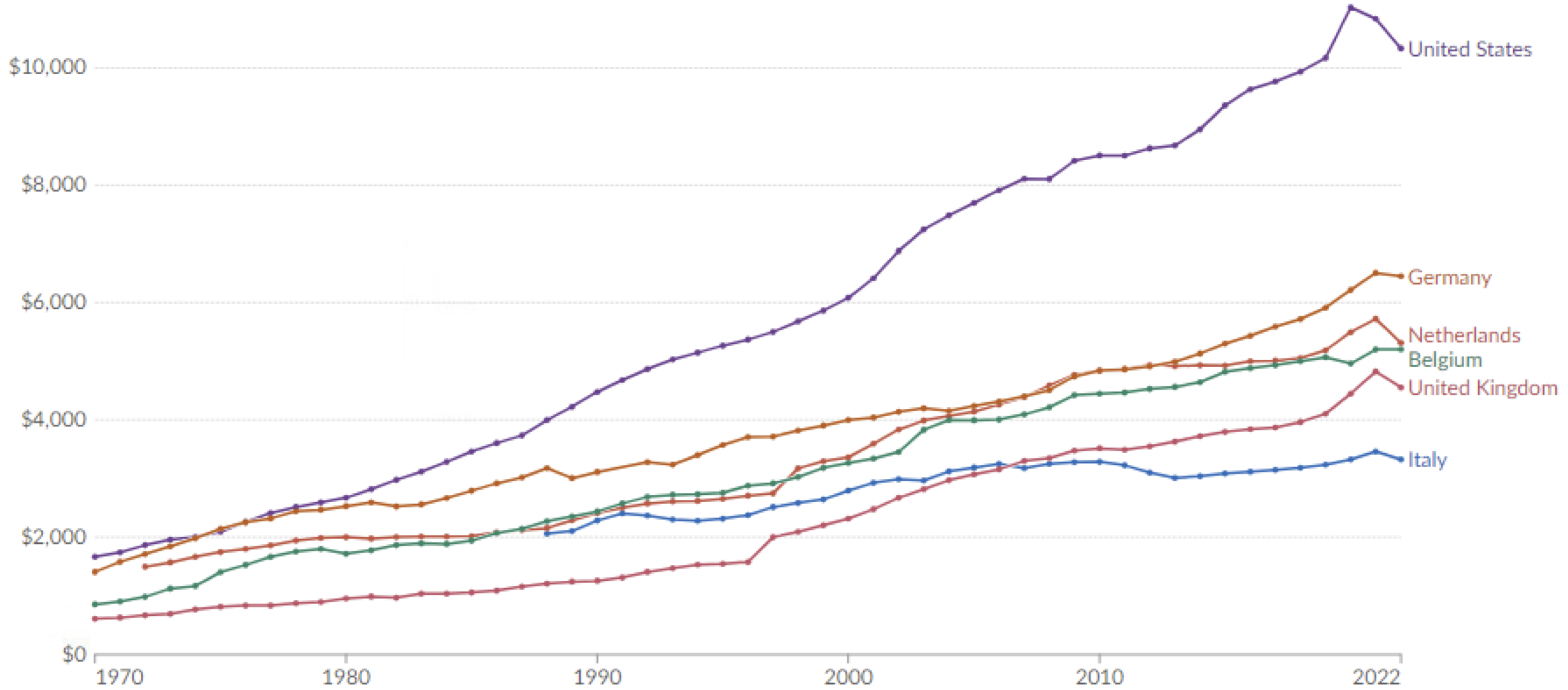
Health expenditure per capita, 1970 to 2022

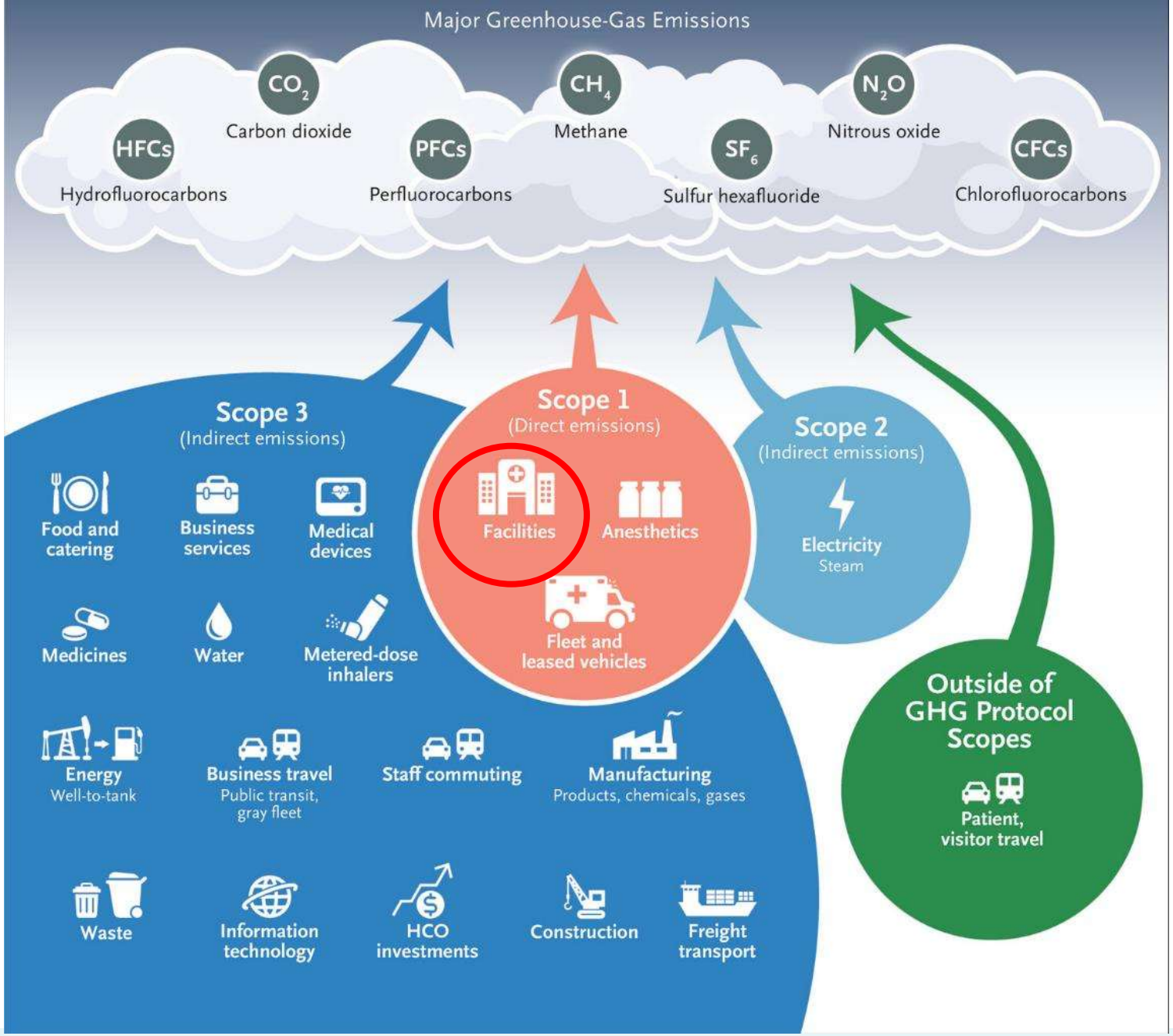
Our World in Data

Health expenditure includes all financing schemes and covers all aspects of healthcare. This data is adjusted for inflation and differences in the cost of living between countries.

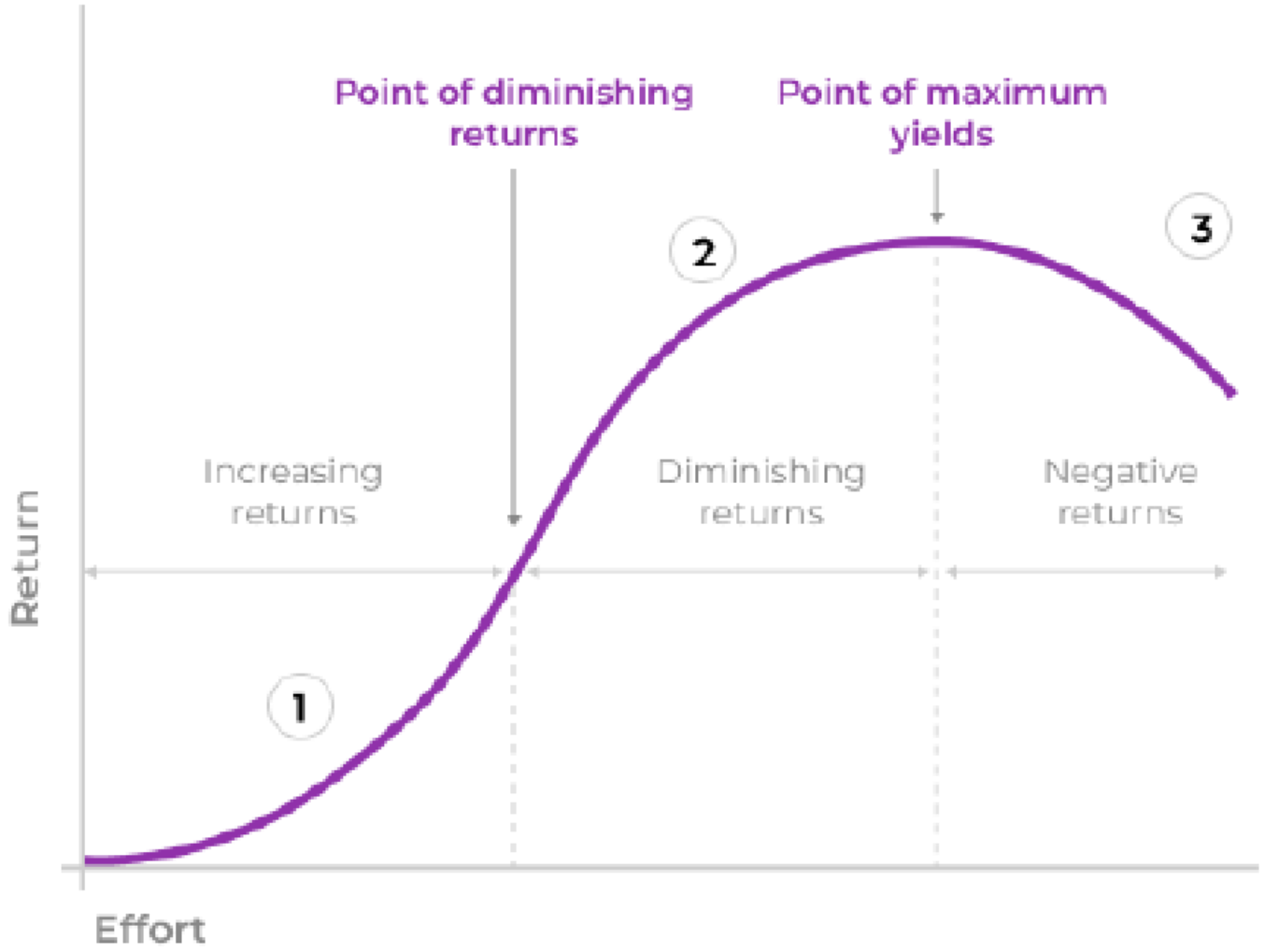
Table | Chart

Settings





Singh 2022 NEJM



Gupta. Voorkom de volgende golf. 2021

A biased selection

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Robotic versus laparoscopic general surgery in the emergency setting: a systematic review

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Review > Minim Invasive Ther Allied Technol. 2024 May 31:1-9. doi: 10.1080/13645706.2024.2359705. Online ahead of print.

Robotic versus laparoscopic surgery for colorectal cancer in older patients: a systematic review and meta-analysis

Xinyu Wang [1], Rui Ma [1], Tiewei Hou [1], Hao Xu [1], Cheng Zhang [1], Chun Ye [1]

Conclusion: This first meta-analysis comparing outcomes of robotic and laparoscopic surgery in older colorectal cancer patients shows that both approaches result in no difference in operating time, complication rates, conversion to open surgery, reoperation rates, and LOS. Scarce data shows that

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Ann Surg Open. 2023 Apr 28;4(2):e284. doi: 10.1097/AS9.0000000000000284.

Surgical stress: the muscle and cognitive demands of robotic and laparoscopic surgery

Abdul Shugaba [1 2], Daren A Subar [3 2], Kate Slade [4], Mark Willett [3], Mohammed Abdel-Aty [3], Iain Campbell [3], Nick Heywood [3], Louis Vitone [3], Adnan Sheikh [3], Mike Gill [3], Bachar Zelhof [5], Helen E Nuttall [4], Theodoros M Bampouras [6], Christopher J Gaffney [1]

Conclusion: These data suggest greater muscle demands in laparoscopic surgery, but greater cognitive demands in robotic surgery.

Surg Endosc. 2022 Nov;36(11):8397-8402. doi: 10.1007/s00464-022-09105-0. Epub 2022 Feb 19.

A comparison of laparoscopic and robotic ergonomic risk

Sara Monfared [1], Dimitrios I Athanasiadis [1], Luke Umana [1], Edward Hernandez [1], Hamed Asadi [2], Cameron L Colgate [1], Denny Yu [2], Dimitrios Stefanidis [3]

Conclusion: Robotic assisted surgeries led to lower postoperative discomfort and muscle strain in

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SHARE

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- Evaluate innovations with minimal patient benefits in relation to their overall resource and environmental costs

- Evaluate the health benefits lost due to resource allocation to accommodate new technologies (health opportunity costs)

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→ Care that is NOT provided to other patients with expected higher quality-adjusted life year (QALY) gain

SHARE – AIMS

Health Technology Assessment and Life Cycle Assessment

→ to analyze the ecological and environmental impacts of robotic surgery compared to traditional laparoscopy

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→ guiding resource allocation and indication assessment for robotic surgery, to prioritize public health over minimal patient benefits

→ develop a novel metric to assess overall resource efficiency (e.g. time, money, personnel, space, equipment, maintenance) enabling quantification of care withheld from other patients when opting for new medical interventions

SHARE

The next generation of surgical robotics is poised to transform healthcare systems around the world.

- A robot that can "feel" whether tissue is healthy or diseased
- Implement AI

Whether this will result in substantial patient and societal benefit depends critically on whether innovation is guided by appropriate evaluation.

Marcus HJ, et al; IDEAL Robotics Colloquium. Nat Med. 2024

Elke Bos
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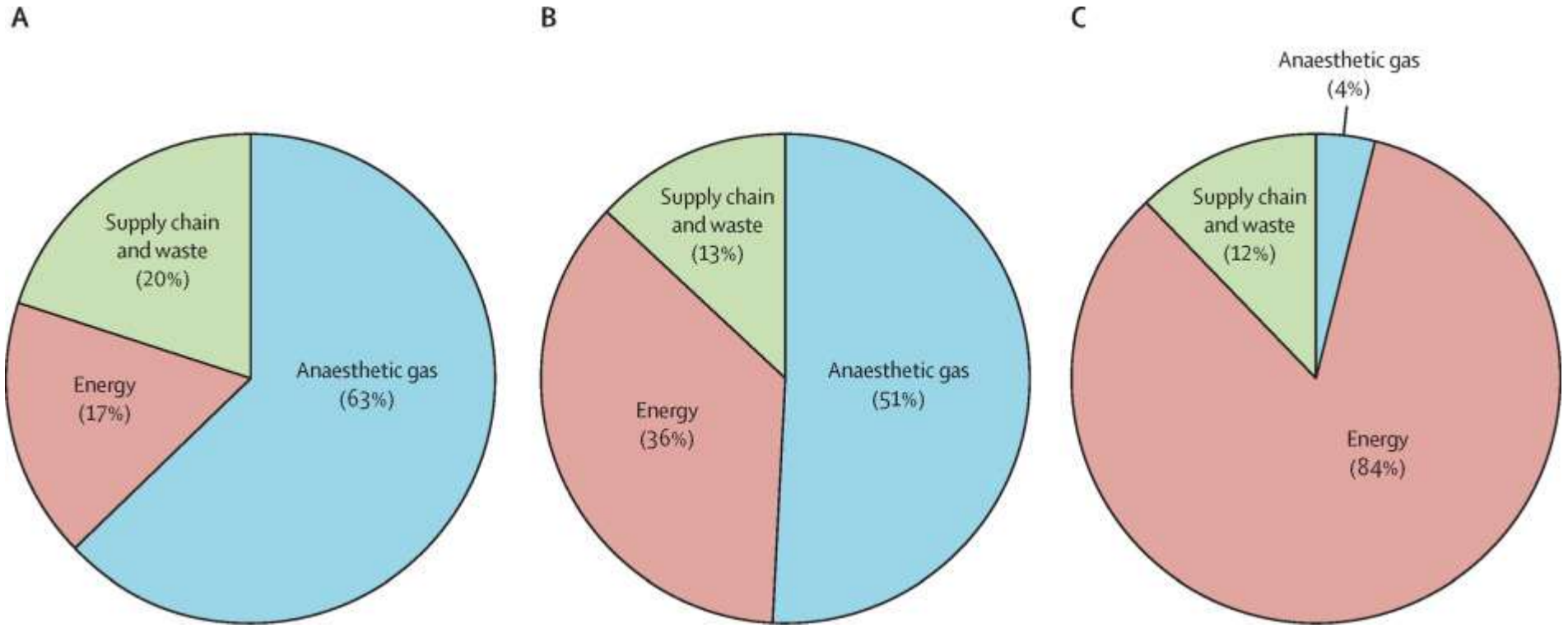
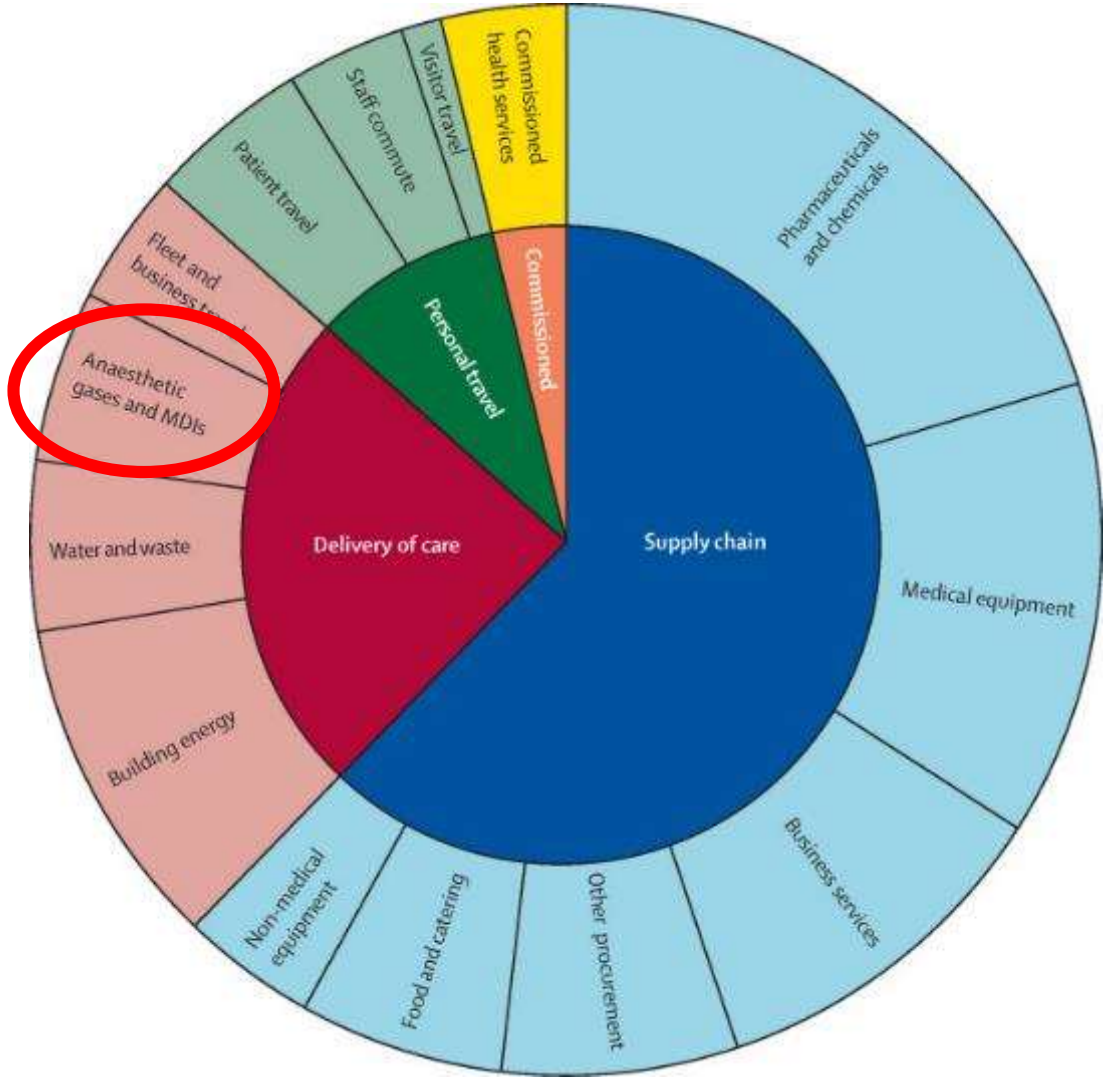
OK uitstoot: aandeel anesthesiegassen



MacNeil 2017 Lancet Planetary Health

Aandeel damp in CO_2-eq

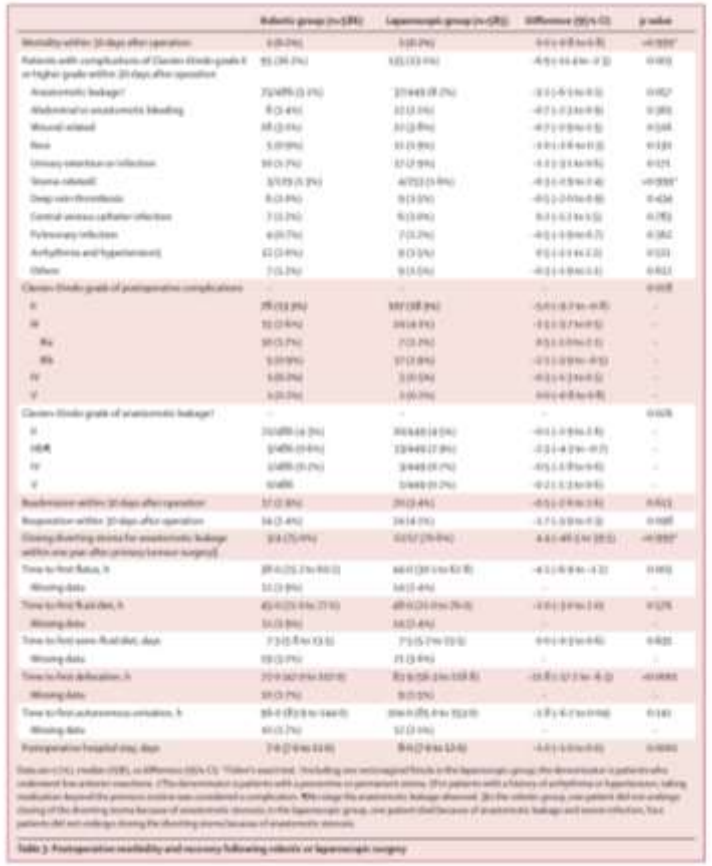
3% van totale uitstoot van de zorg door inhalatieanesthetica



Tennison 2021 Lancet Planetary Health

Feng Q, et al. Robotic versus laparoscopic surgery for middle and low rectal cancer (REAL): short-term outcomes of a multicentre randomised controlled trial. Lancet Gastroenterol Hepatol. 2022 Nov;7(11):991-1004.

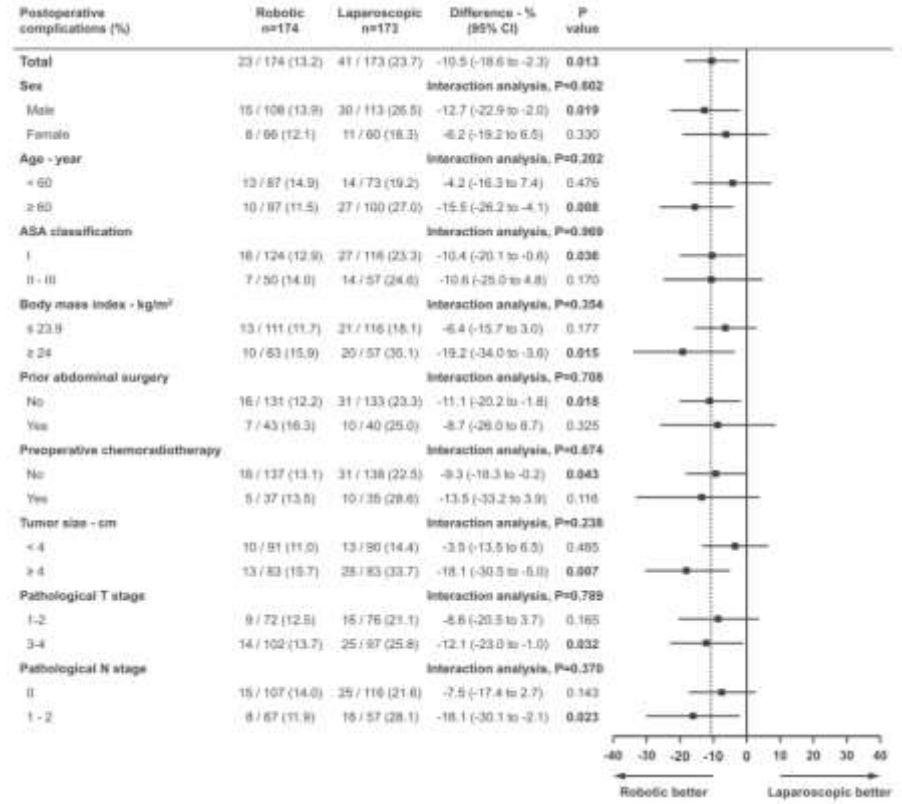
- multicentre, randomised, controlled, superiority trial, 2016 – 2020, middle and low rectal cancer.
- Primary end-point: The 3-year locoregional recurrence rate
- Secondary end-points: circumferential resection margin positivity and 30-day postoperative complications (Clavien-Dindo classification grade II or higher)
- Power calculation: The 3-year locoregional recurrence rate was estimated to be 7% in the laparoscopic group. The hazard ratio of the robotic group was estimated to be 0·5 based on previous reports. With the power (1-β) at 0·9 and significance level (α) at 0·05, 522 cases for each group were required to achieve statistical significance.



Secondary short-term outcomes suggest that for middle and low rectal cancer, robotic surgery resulted in better oncological quality of resection than conventional laparoscopic surgery, with less surgical trauma, and better postoperative recovery

Feng Q, et al. Robotic versus laparoscopic abdominoperineal resections for low rectal cancer: A single-center randomized controlled trial. J Surg Oncol. 2022 Dec;126(8):1481-1493.

- RCT, single center, double blinded, 2013 – 2016, robotic and laparoscopic abdominoperineal resections (APRs)
- 174 robotic vs 173 laparoscopic
- Primary end-point: 30-day postoperative complication rate (Clavien–Dindo grade II orhigher) of the intent-to-treat population
- Secondary end-points: secondary outcomes ERAS protocol compliance, surgical quality, pathological outcomes, postoperative short-term recovery, urinary and sexual function, and long-term oncological outcomes.
- Power calculation: The estimated sample size was 342 patients (171 in each group). Thissize provided 80% power at the 5% (two-sided) level of significance to detect a reduction in the postoperative complication rate from25% in the laparoscopic group (according to previously reports 20) to12% (according to the unpublished data of our center) in the robotic group using Fisher's exact test, allowing for 10% attrition.



Luo C, et al. Efficacy and safety outcomes of robotic radical hysterectomy in Chinese older women with cervical cancer compared with laparoscopic radical hysterectomy. BMC Womens Health. 2018 May 1;18(1):61.

- RCT, double blinded, 2014 – 2015
- 30 robotic radical hysterectomy (RRH) vs 30 laparoscopic radical hysterectomy (LRH)
- Primary end-point: Numbers of recurrence and death.
- Secondary end-points: postoperative complications and length of postoperative hospital stay
- Power calculation??

Table 2 Postoperative complications and survival outcomes

Characteristics	RRH group	LRH group	*P* value
Total number of Postoperative complications, *n* (%)	4(6.7)	11(18.3)	0.037
Febrile morbidity, *n* (%)	2(6.7)	5(16.7)	0.421
Port site cellulitis/hernia/dehiscence, *n* (%)	1(3.3)	3(10.0)	0.605
Urinary tract infection, *n* (%)	1(3.3)	2(6.7)	1.000
Ureteral injury, *n* (%)	0(0)	1(3.3)	1.000
Indwelling bladder catheter time[a], d	6(5-11)	7(6-11)	0.043
Indwelling drain catheter time[a], d	29(23-36)	32(28-38)	0.038
Length of postoperative hospital stay[a], d	13(10-15)	15(11-17)	0.042
Recurrence, *n* (%)	2(6.7)	3(10.0)	1.000
Death, *n* (%)	1(3.3)	2(6.7)	1.000

Notes: [a]median (interquartile range). Abbreviations: *RRH* robotic radical hysterectomy, *LRH* laparoscopic radical hysterectomy

Lu J, et al. Assessment of Robotic Versus Laparoscopic Distal Gastrectomy for Gastric Cancer: A Randomized Controlled Trial. Ann Surg. 2021 May 1;273(5):858-867.

- Open-label, non-inferiority RCT, non-blinded, 2017 – 2020
- 141 robotic distal gastrectomy (RDG) vs 142 laparoscopic distal gastrectomy (LDG)
- Primary end-point: 3-year disease free survival
- Secondary end-points: ?
- Power calculation Power calculation: projected 3-year disease-free survival rate for the LDG group was 82.3%. Based on an alpha of 0.025, a power of 90%, and a margin delta of 16% → 120 pt per group (expected dropout rate of 20%, total of 300 pts)

TABLE 2. Postoperative Recovery, Morbidity and Mortality Following RDG or LDG

	RDG (n = 141)	LDG (n = 142)	
	Mean ± SD / N (%)	Mean ± SD / N (%)	*P* value
Postoperative recovery			
Time to ambulation (d)	2.0 ± 0.7	2.5 ± 1.8	0.005
Time to first flatus (d)	3.2 ± 0.6	3.5 ± 0.9	<0.001
Time to first liquid intake (d)	3.5 ± 0.6	3.9 ± 1.3	0.001
Drainage tube removed time (d)	6.5 ± 1.8	7.0 ± 2.5	0.103
Postoperative hospital stay (d)	7.9 ± 3.4	8.2 ± 2.5	0.062
Postoperative transfusion	8 (5.7%)	16 (11.3%)	0.091
Reoperation	0 (0.0%)	1 (0.7%)	1.000
Overall morbidity	13 (9.2%)	25 (17.6%)	0.039
Surgical morbidity	5 (3.5%)	9 (6.3%)	0.279
Abdominal bleeding	1 (0.7%)	3 (2.1%)	0.622
Anastomotic leakage	0 (0.0%)	1 (0.7%)	1.000
Ileus	1 (0.7%)	1 (0.7%)	1.000
Gastroplegia	0 (0.0%)	1 (0.7%)	1.000
Wound infection	1 (0.7%)	1 (0.7%)	1.000
Peritoneal infection	3 (2.1%)	2 (1.4%)	0.684
Medical morbidity	9 (6.4%)	20 (14.1%)	0.033
Pneumonia	8 (5.7%)	16 (11.3%)	0.091
Cardiovascular system	1 (0.7%)	1 (0.7%)	1.000
Liver system	2 (1.4%)	1 (0.7%)	0.622
Urinary system	1 (0.7%)	2 (1.4%)	1.000
Deep vein thrombosis	0 (0.0%)	1 (0.7%)	1.000
Unplanned readmission	2 (1.4%)	2 (1.4%)	1.000
Peritoneal infection	1 (0.7%)	1 (0.7%)	1.000
Pneumonia	0 (0.0%)	1 (0.7%)	1.000
Gastroplegia	1 (0.7%)	0 (0.0%)	0.498
Clavien-Dindo classification			0.263
I	0 (0.0%)	0 (0.0%)	
II	11 (7.8%)	22 (15.5%)	
IIIa	0 (0.0%)	1 (0.7%)	
IIIb	1 (0.7%)	1 (0.7%)	
IV	1 (0.7%)	1 (0.7%)	
V	0 (0.0%)	0 (0.0%)	
In-hospital mortality	0 (0.0%)	0 (0.0%)	—

SD indicates standard deviation.

Kawka M, et al. Laparoscopic versus robotic abdominal and pelvic surgery: a systematic review of randomised controlled trials. Surg Endosc. 2023 Sep;37(9):6672-6681.

- None of the studies found longterm significant differences (mortality/morbidity)
- Short term total complication rate
    - (n=31/35, 88.6%) studies: no signifcant difference
    - (n=4/35, 11.4%) studies: found a lower total complication rate in the robotic group

Conclusion here were no signifcant diferences between robotic surgery and laparoscopic surgery with regards to mortality and morbidity outcomes in the majority of studies. Robotic surgery was frequently associated with longer operative times and higher overall cost. Selected studies found potential benefts in post-operative recovery time, and patient-reported outcomes; however, these were not consistent across procedures and trials, with most studies being underpowered to detect diferences in secondary outcomes. Future research should focus on assessing quality of life, and long-term outcomes to further elucidate where the robotic platform could lead to patient benefts, as the technology evolves.