Planeteary Health Academy
12.01.2022

Urologie und Planetary Health

Prof. Dr. med. Steffen Rausch, FEBU

Klinik für Urologie

Universitätsklinikum Tübingen

Inhalt

Teil 1

Beispiele: Welche Rolle spielt der Klimawandel für urologische Erkrankungen?

Teil 2

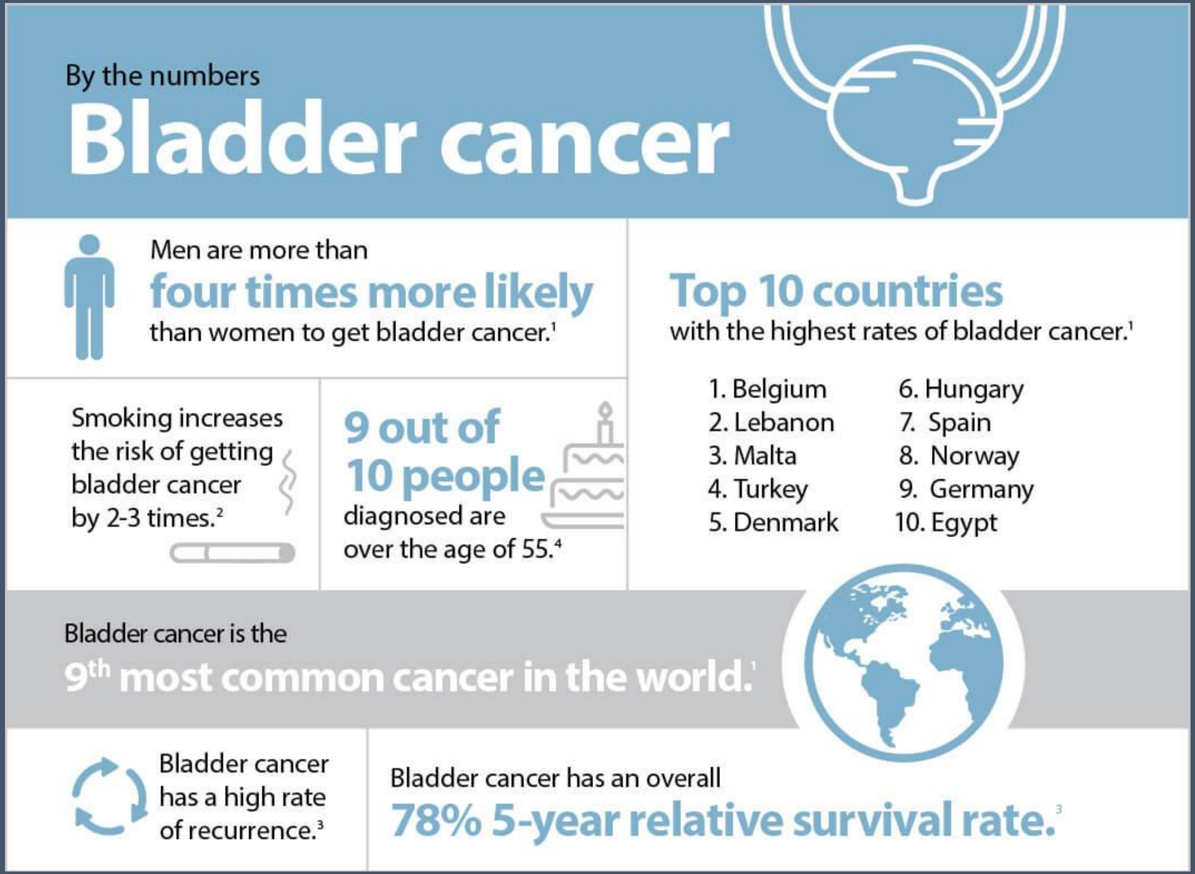
Welche Rolle spielt die Urologie für die planetare Gesundheit ?

Urologie

- **Erkrankungen der ableitenden Harnwege**
- **Ältere und alternde Gesellschaft**
- **Onkologischer Schwerpunkt (insbes: Prostata-, Harnblasen-, Nierenzellkarzinom)**
- **Innovative operative und interventionelle Verfahren**

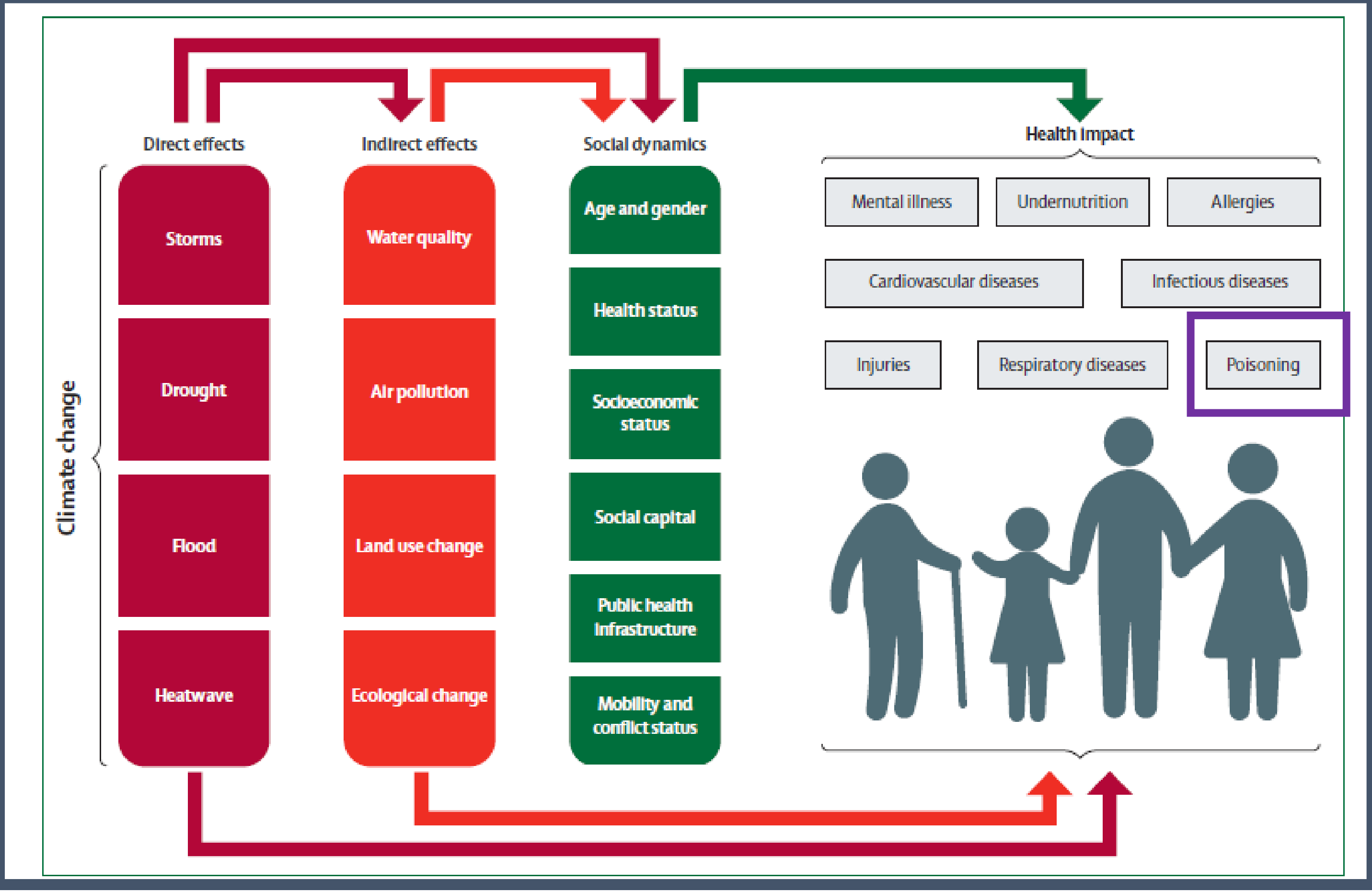
Rassweiler et al. Akt Urol, 2018

Harnblasenkarzinom



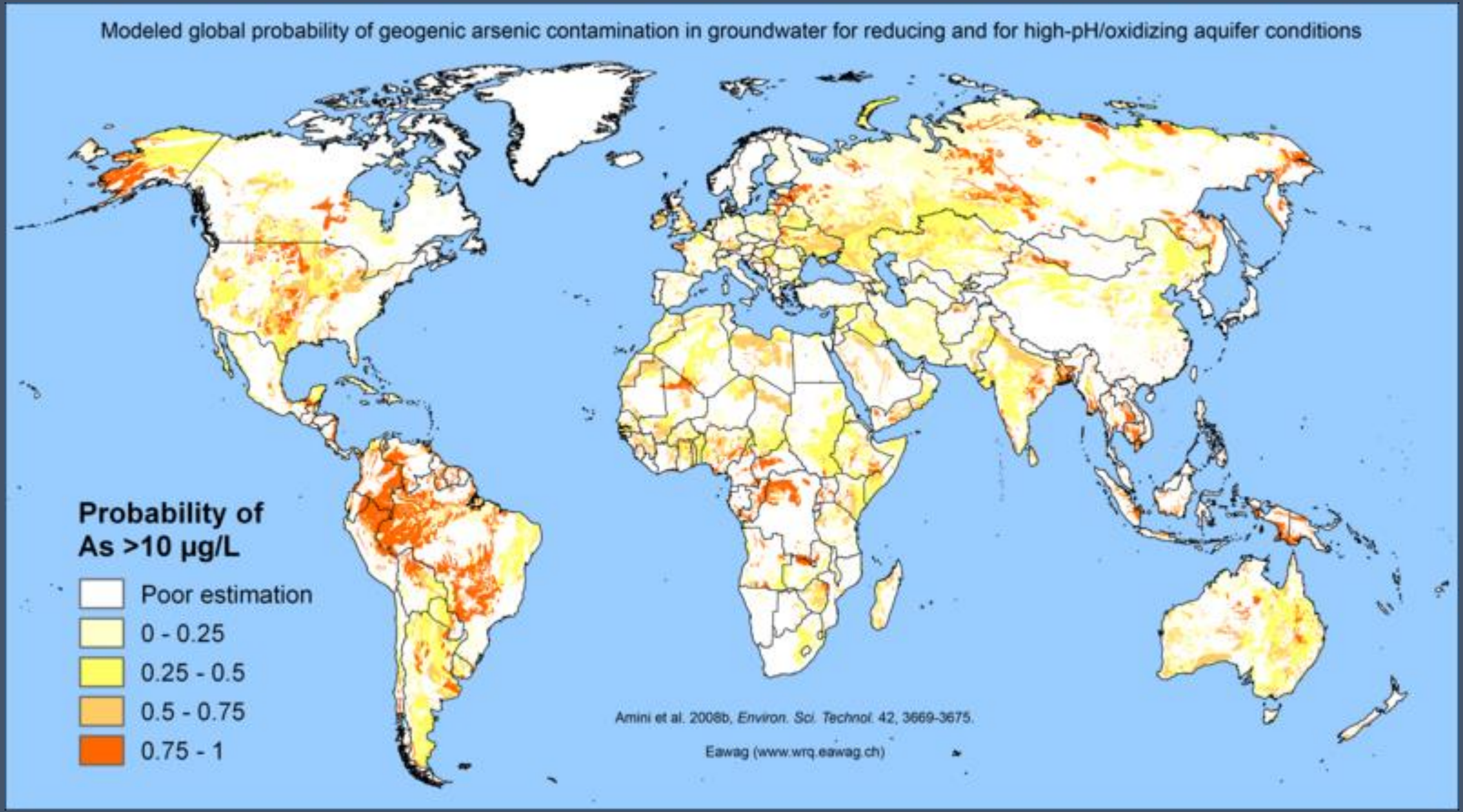
https://www.cookmedical.com/urology/a-closer-look-at-bladder-cancer/

Auswirkungen Klimawandel - Gesundheit



Watts et al. Lancet, 2015

Arsenbelastung im Trinkwasser



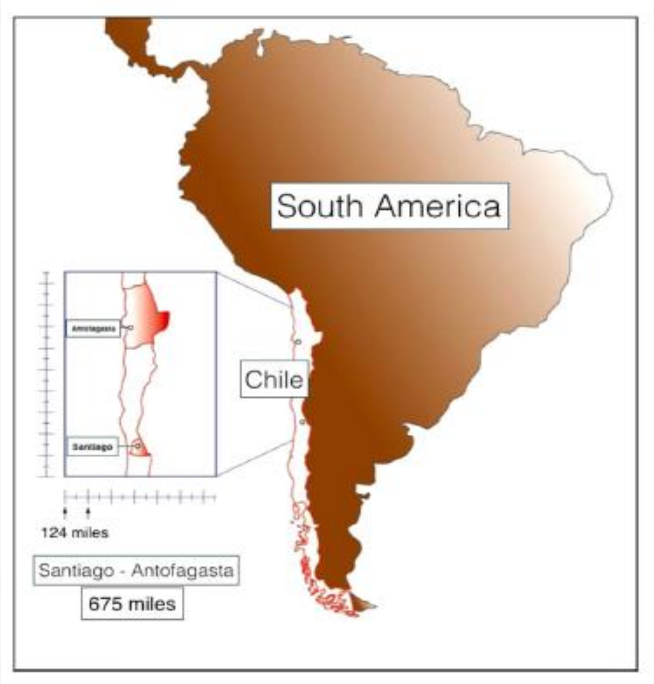
Amini et al. Envrion Sci Technol, 2008

Arsenexpositon und Harnblasenkarzinome: Beispiel Chile (Antofagsta)

Clinical-Bladder cancer

Impact of arsenic exposure on clinicopathological characteristics of bladder cancer: A comparative study between patients from an arsenic-exposed region and nonexposed reference sites

UROLOGIC ONCOLOGY



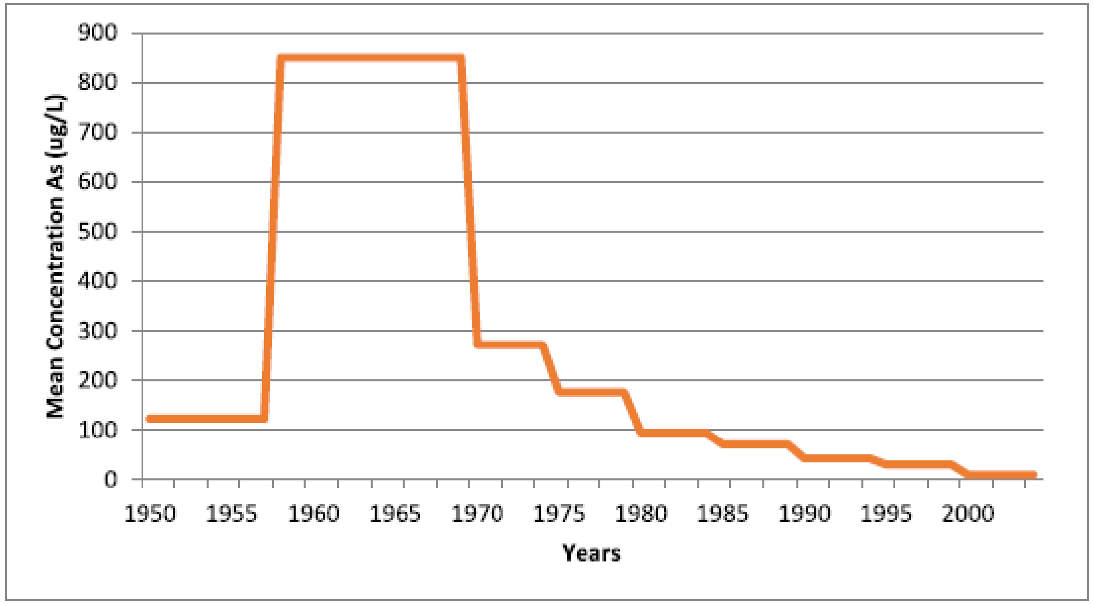


Fig. 1. Mean arsenic concentrations in the city of Antofagasta during the last decades.

Fernandez et al. Urol Oncol, 2019

Arsenexpositon und Harnblasenkarzinome: Beispiel Chile (Antofagsta)

Clinical-Bladder cancer

Impact of arsenic exposure on clinicopathological characteristics of bladder cancer: A comparative study between patients from an arsenic-exposed region and nonexposed reference sites

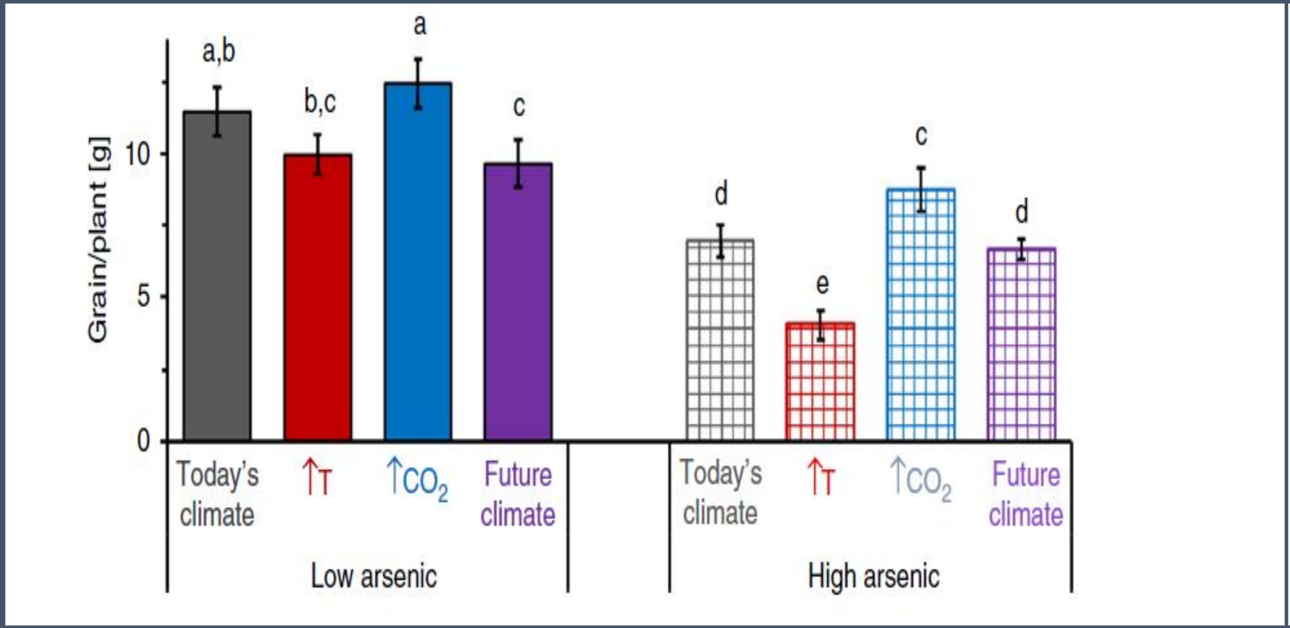
UROLOGIC ONCOLOGY

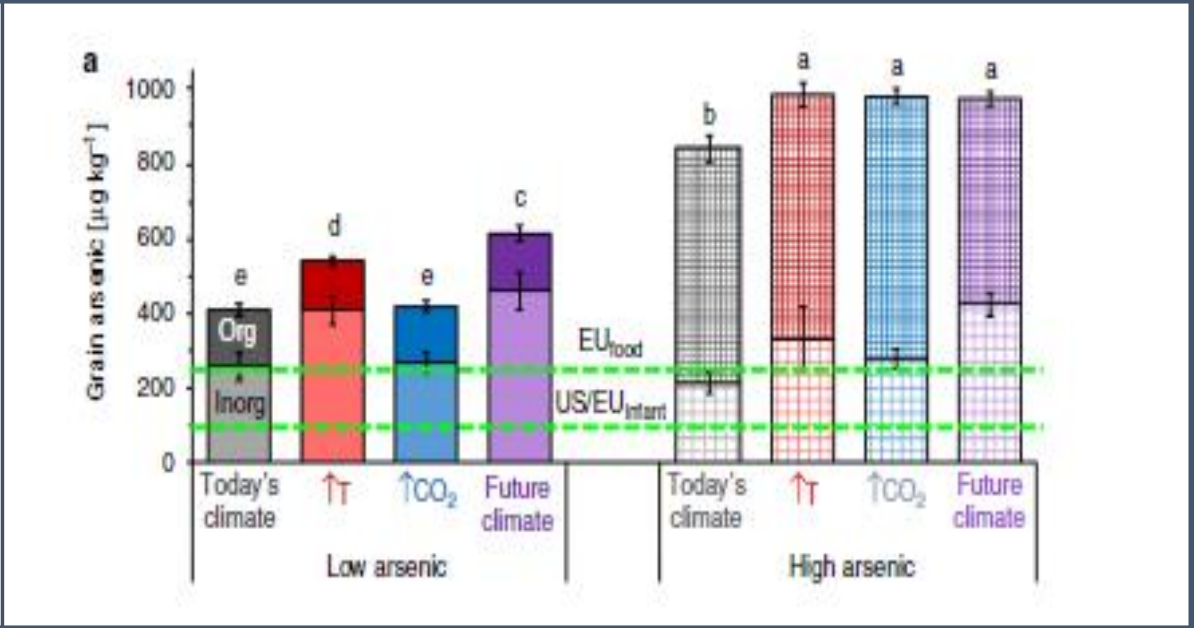
	Univariate analysis				Multivariable logistic regression		
Variable	N	OR	95% CI	*P* value	OR	95% CI	*P* value
Age	278	1.02	0.99–1.04	0.21	1.02	0.99–1.05	0.13
Female gender	278	1.24	0.68–2.24	0.48	1.21	0.64–2.29	0.56
Family history of BC	277	2.49	0.76–8.19	0.13	1.78	0.54–5.91	0.34
Ever smoker	264	0.99	0.53–1.82	0.96	1.54	0.74–3.18	0.25
Current smoker	264	0.83	0.46–1.51	0.55	1.12	0.57–2.20	0.74
Low or middle socioeconomic status	278	1.84	1.09–3.11	**0.023**	0.97	0.49–1.91	0.92
Arsenic exposure	278	3.74	1.81–7.71	**<0.001**	5.10	2.03–12.77	**0.001**

Fernandez et al. Urol Oncol, 2019

Arsenexpositon als Folge globaler Erwärmung

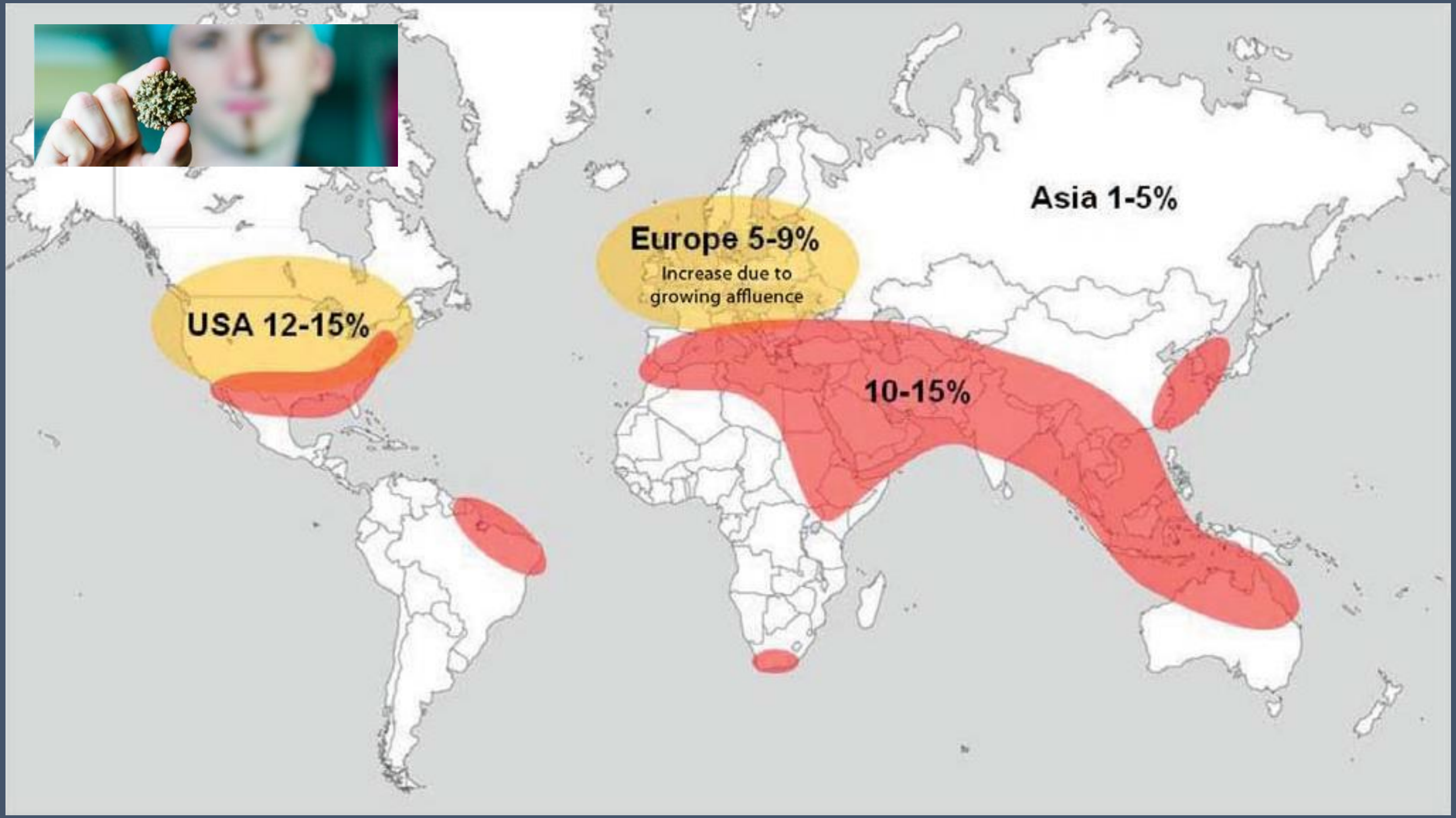
Rice production threatened by coupled stresses of climate and soil arsenic





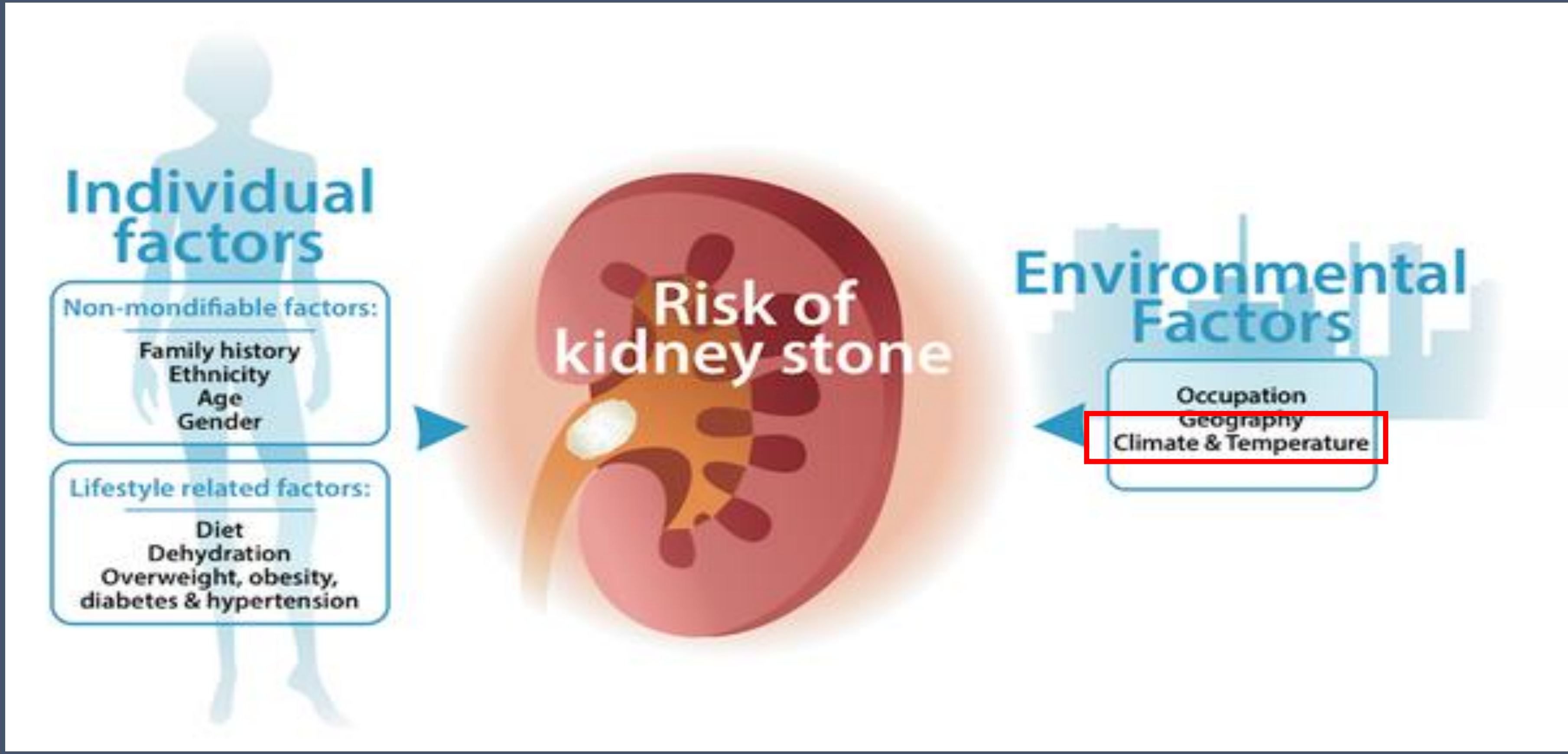
Muehe et al. Nature Comm, 2019

„stone belt“: Regionale Variation der Urolithiasis-Prävalenz



Fisang et al. Dtsch Aerztebl Int, 2015

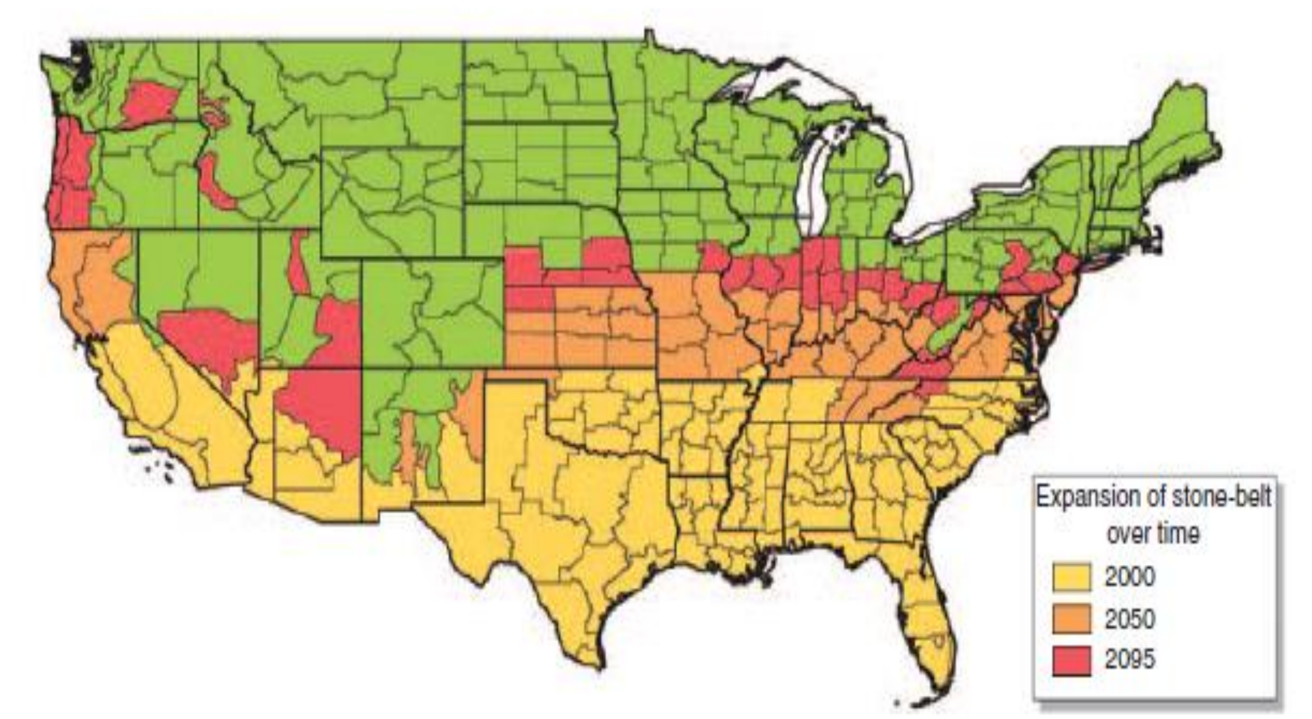
Risikofaktoren: Urolithiasis

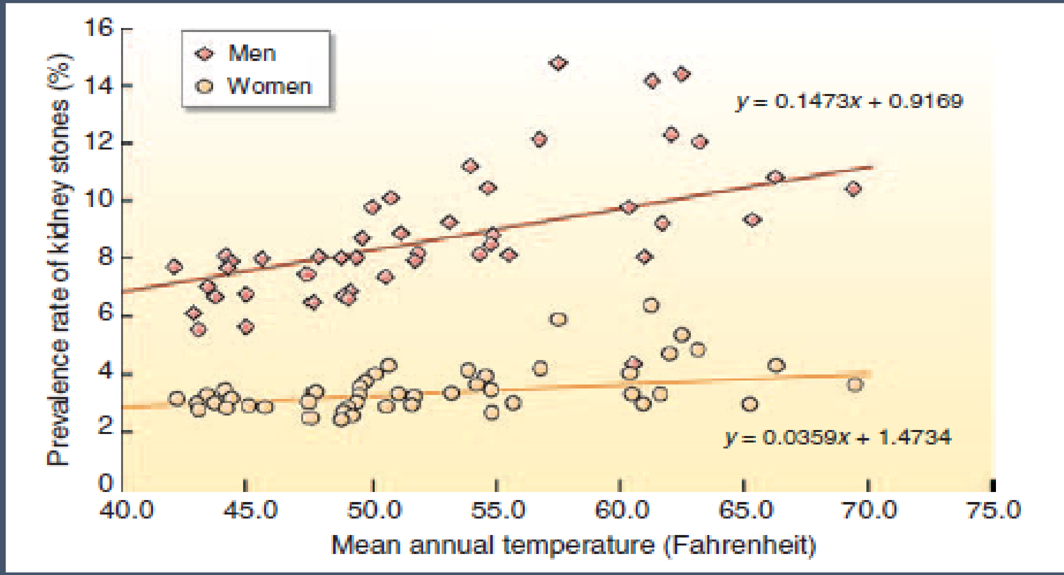


Klimawandel und Urolithiasis-Inzidenz

Ambient temperature as a contributor to kidney stone formation: implications of global warming

Robert J. Fakheri[1] and David S. Goldfarb[1,2]





Fakheri and Goldfarb, Kidney Int, 2011

Präventionsmaßnahmen: Urolithiasis

Increased fluid intake	• **Urine volume > 2.0L/d** • Urine Specific Gravity < 1,010
Balanced diet	• **Normal calcium intake** (1,000-1,200 mg/d) • **Limit salt** intake (4-5 g/d) • **Limit animal protein** intake (0.8-1g/kg/d)
Lifestyle	• **BMI** 18-25 • Limit stress • **Adequate physical activity** • Balancing excessive fluid loss

Figure 9. General measures for the prevention of kidney stone recurrence based on European Association of Urology guidelines for nephrolithiasis patients.
(adapted from Tiselius et al. 2001).

Prävention (Hydratation) und Effekte auf das Gesundheitssystem

BJUI

Primary prevention of nephrolithiasis is cost-effective for a national healthcare system

Yair Lotan, Inmaculada Buendia Jiménez*, Irene Lenoir-Wijnkoop*, Michel Daudon†, Laurent Molinier‡, Ivan Tack§ and Mark J.C. Nuijten¶

Department of Urology, University of Texas Southwestern Medical Center, Dallas, TX, USA, *Danone Research RD128, 91767 Palaiseau Cedex, †Department of Clinical Physiology, Tenon Hospital, Paris, ‡Department of Medical Information, Hospitals of Toulouse, Toulouse, §Department of Clinical Physiology, CHU Rangueil, INSERM U1048 Toulouse, France, and ¶Ars Accessus Medica, Amsterdam, The Netherlands

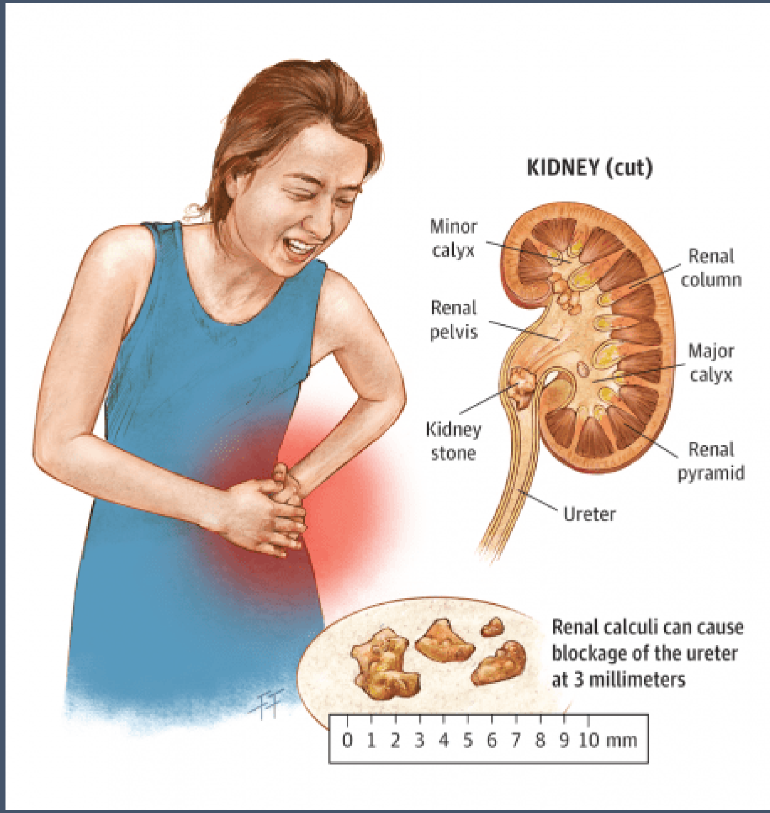
Accepted for publication 29 February 2012

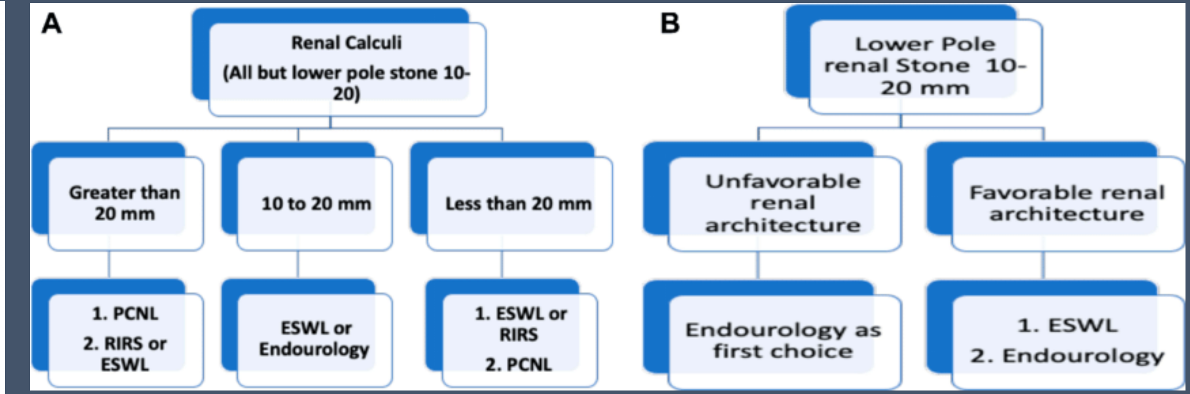
TABLE 3 Cost of care results (annual budget)

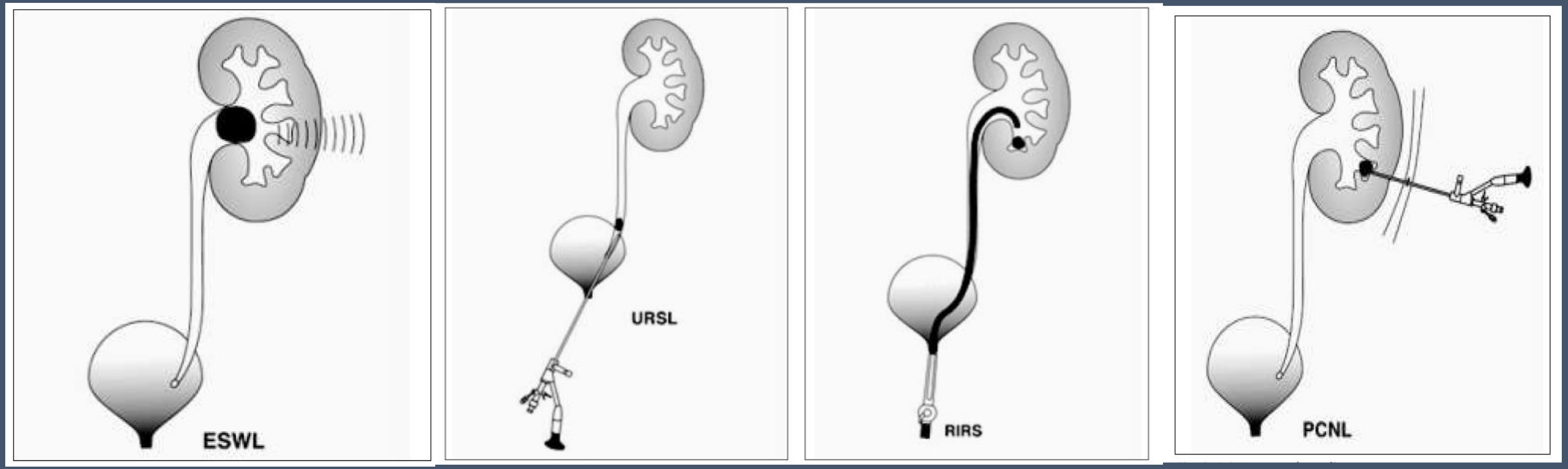
Population compliance with 2 L fluid/day	Savings (€ million)			Number of stone events prevented
	Medical costs	Indirect costs	Total	
100%	177	96	273	9265
80%	141	77	218	7412
75%	132	72	205	6949
50%	88	48	137	4633
25%	44	24	68	2316

Lotan et al. BJUI, 2012

Interventionelle Therapie der Urolithiasis

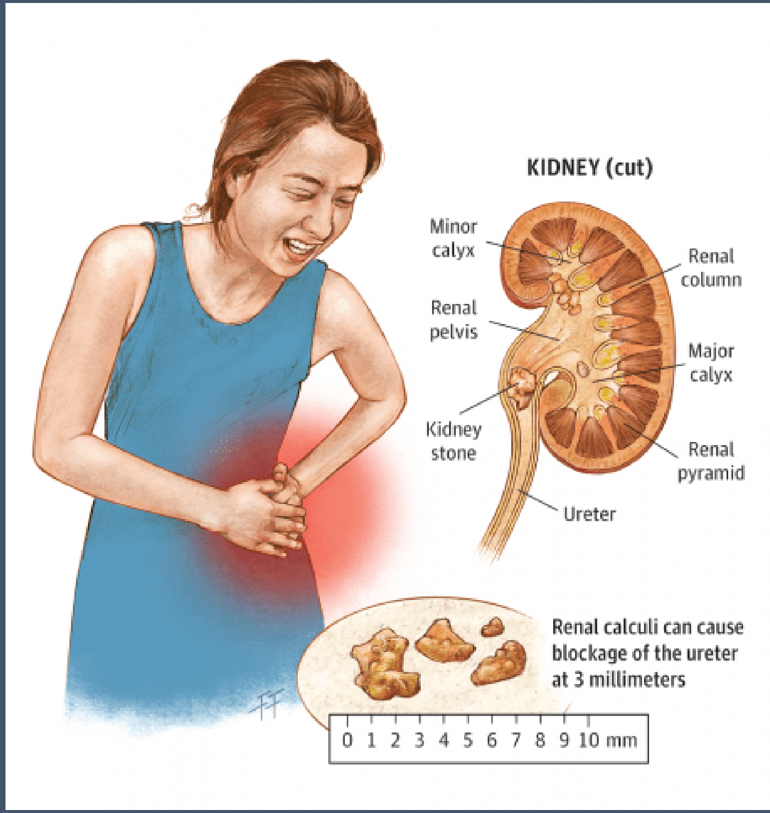


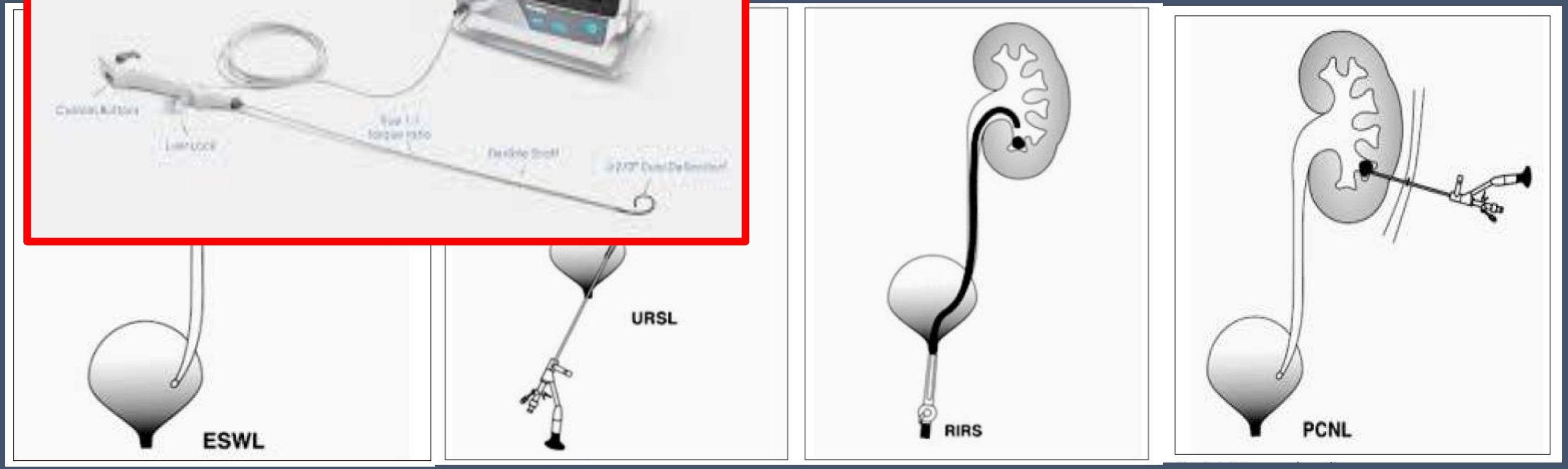




nach: EAU Guidelines; www.uroweb.org

Interventionelle Therapie der Urolithiasis

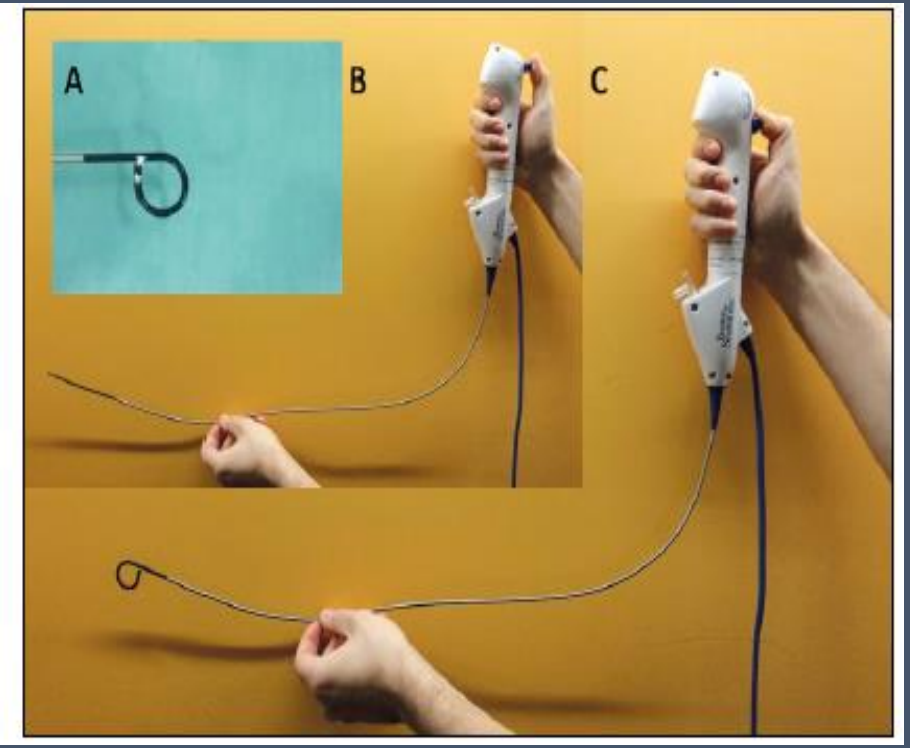




nach: EAU Guidelines; www.uroweb.org

Erwartete Vorteile von Einmalgeräten

- **Kalkulierbare Behandlungskosten**
- **Keine Bildqualitätsverluste durch fabrikneues Gerät und digitale Technik**
- **Hygieneaspekte**
- **Belastbare prospektive Studiendaten „single-use vs. reusable URS"?**



Buttice et al. Cent Eur J Urol, 2016

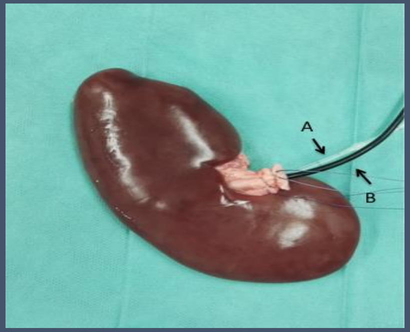
Qualitatives Assessment – Flexible Ureteroskope

ORIGINAL ARTICLE

CrossMark

Single-use versus reusable ureterorenoscopes for retrograde intrarenal surgery (RIRS): systematic comparative analysis of physical and optical properties in three dif erent devices

Susanne Deininger[1] · Luis Haberstock[1] · Stephan Kruck[1] · Eva Neumann[1] · Ines Anselmo da Costa[1] · Tilman Todenhöfer[1] · Jens Bedke[1] · Arnulf Stenzl[1] · Stef en Rausch[1]



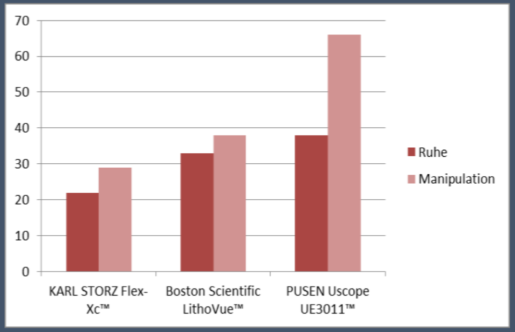


Table 2 Absolute flow rates and change of flow through insertion of devices into ureterorenoscopes

	(1) KARL STORZ Flex-Xc™	(2) Boston Scientific Litho-Vue™	(3) PUSEN Uscope UE3011™
Absolute flow in ml/min	25.8	30.3	33.4
$p < 0.05$ different from factor	(2) (3)	(1) (3)	(2) (3)
	Flow reduction in % through insertion of devices		
Sensor™ guide wire	95.3	93.7	93.7
Zero Tip™ nitinol stone retrieval basket	80.2	80.5	81.1
230-µm laser fiber	79.1	77.6	75.8

Table 3 Subjective evaluation of optical properties (maximum score: 5 points per item and 25 points in total; SD = standard deviation)

	KARL STORZ Flex-Xc™ Average score± SD	Boston Scientific Lithovue™ Average score± SD	PUSEN Uscope UE3011™ Average score± SD
Image fidelity	5.0± 0	3.9± 0.4	4.1± 0.4
Light intensity	4.7± 0.5	4.1± 1.2	3.7± 1.0
Gray Contrast	4.9± 0.4	4.0± 1.5	4.4± 1.1
Color contrast	4.6± 0.5	4.4± 0.8	3.6± 0.5
Image definition	4.9± 0.4	4.6± 0.5	4.3± 1.0
Total	24.1± 0.4	21.0± 0.9	20.1± 0.8

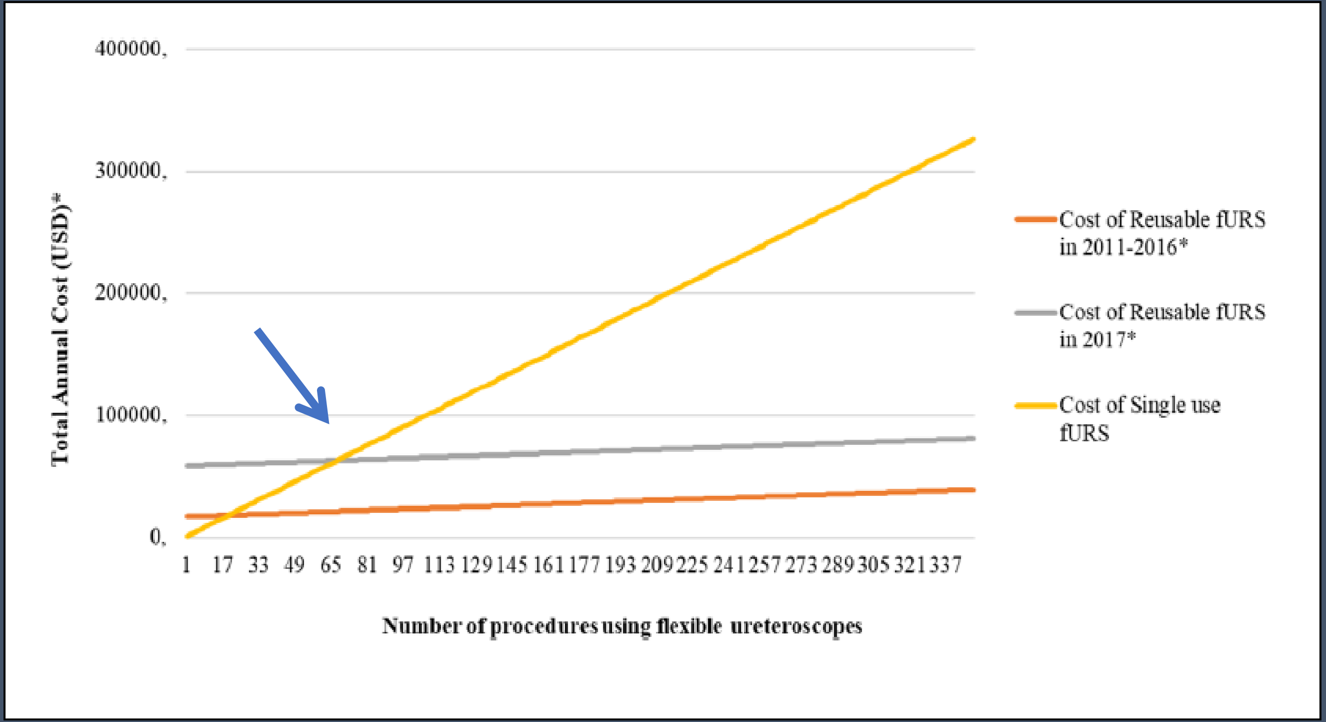
Deininger et al. World J Urol, 2018

Kosten / Effizienz?

Fiberoptisches flexibles URS:

- **17000€ Aqusition / 4800€ Reparatur pro Einheit**
- **29 Anwendungen vor 1. Reparatur / 59 Anw. vor 2. Reparatur**

Vergleichende Daten (unizentrisch) zeigen Kosteneffizenz abhängig von der Fallzahl



Al Balushi et al. Int Urol Nephrol., 2018

Klimarelevanz? CO2-Bilanz sterilisierbare vs. single-use Ureteroskope (LCA)

Carbon footprint in flexible ureteroscopy: A comparative study on the environmental impact of reusable and single-use ureteroscopes

Niall F. Davis, Shannon McGrath, Mark Quinlan, Gregory Jack, Nathan Lawrentschuk, Damien M Bolton

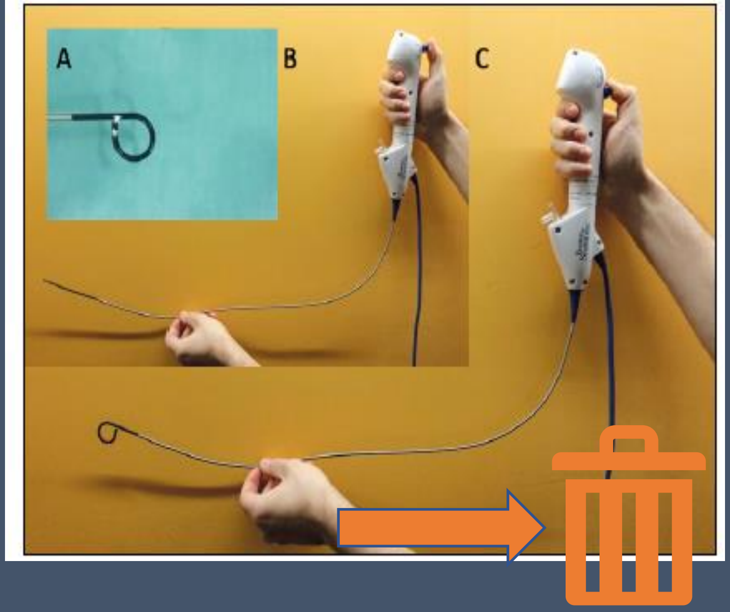


Table 2: Components of the life cycle of disposable and reusable flexible ureteroscopes and the analysis of their total carbon footprint

Process	Carbon footprint (kg of CO_2 per case)
Boston Scientific Lithovue™ single-use digital ureteroscope	
Manufacturing cost (weight of scope 0.3kg)	3.83
Solid waste = 0.3kg	0.3
Sterilisation (6)	0.3
Total per case	**4.43**
Olympus Flexible Video Ureteroscope (URV-F™)*	
Manufacturing cost (weight of scope 1kg)	0.06
Washing/Sterilisation** (165 litres)	3.95
Repackaging with theatre wrap (3)	<0.005
Repair cost (estimated 5kg CO2/repair)	0.45
Solid waste of flexible ureteroscope = 1kg	0.005
Total per case	**4.47**

*Lifecycle of 180 uses and 11 repairs (i.e. 180/16)

** Sterilisation machine used – Olympus ETD4. Olympus ETD4 uses 9.2kW per cycle = each cycle takes 70 minutes and sterilises 2 scopes = 7.9kW/hr = 7.9kg CO_2[7]

Davis et al. J Endourol, 2018

CO2-Fußabdruck
Minimal-invasive Chirurgie

Table 1. Total Scope 1 Carbon Emissions for Minimally Invasive Surgery

	Total number of procedures		
	Inpatient	*Outpatient*	*Total hours*
Gastrointestinal			
Cholecystectomy	374,485	348,000	722,485
Appendectomy	218,558	227,000	277,850
Bariatric surgery	126,850	151,000	445,558
Colon	77,108		
Gynecologic			
Hysterectomy	91,835	84,000	527,505
Salpingo-oophorectomy/tubal ligation	389,288	91,000	240,144
Urology			
Prostatectomy	90,000		360,000
Nephrectomy (partial/radical/nephro-U)	34,022		102,066
Miscellaneous			
Laparoscopy NOS	64,569	59,000	123,569
Robot-assisted procedures NOS	93,508	280,524	374,032
Total hours		3,233,917	Hours
Total # CO_2 cylinders		2,021,298	Cylinders
Total CO_2 emission		303.0	Tonnes

NOS = natural orifice surgery.

Table 2. Total Scope 2 and 3 Carbon Emissions for Minimally Invasive Surgery

CO_2 capture/compression		*$USD (millions)*	
U.S. CO_2 supplier	Total global sales (adjusted for inflation) 2009	9102	
	U.S. sales (52%)	4733	
	Medical sector (11%)	521	
	Packaged gas (31%)	161	
	MSKCC MIS correction (43%)	69	
		CO_2 emissions	
EIOLCA calculation	Industrial gas manufacturing	251 000	
	Power generation and supply	83 700	
	Gas extraction	16 700	
	Subtotal CO_2 emissions	351,400	Tonnes
CO_2 transportation	Number of CO_2 cylinders	2,021,198	Cylinders
	Total miles/all cylinders	4,042,396	Miles
US DOT/GHGPI calculation	Subtotal CO_2 emissions	2970	Tonnes
Incineration of biomedical waste			
U.S. laparoscopic trocar data 2004	Number of disposable laparoscopic trocars	6,200,000	Trocars
	Average weight of trocar	30	Grams
	Total weight plastic	186,000	kg
U.S. robotic instrument data 2009	0.8 kg/unloaded instruments/10 uses		
	Total weight plastic	22,441	kg
	Subtotal CO_2 emissions	1251	Tonnes
	Total scope 2–3 CO_2 emissions	355,621	tonnes

Power et al. J Endourol, 2012

CO2-Fußabruck
Minimal-invasive Chirurgie

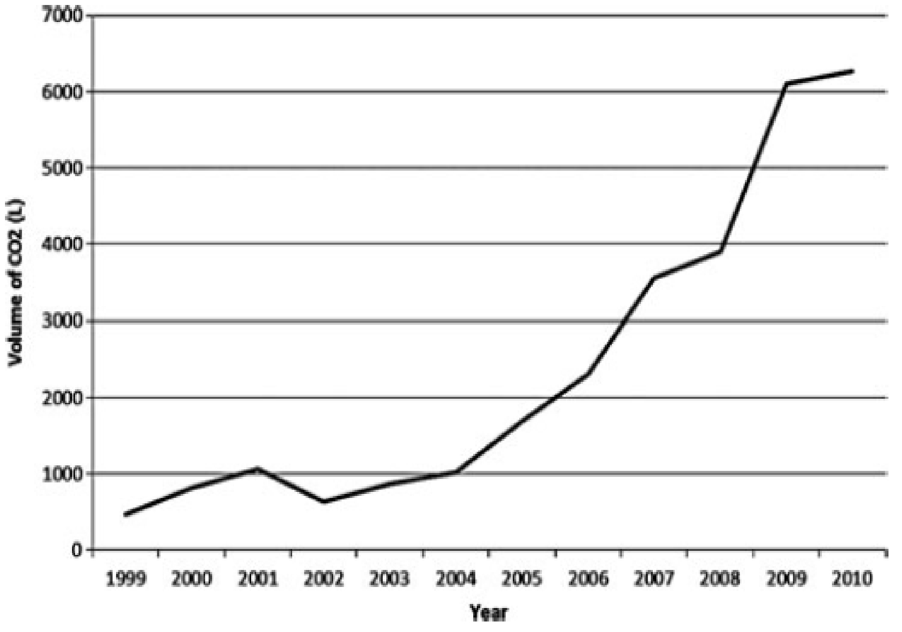


FIG. 1. Our institution's volume of carbon dioxide operating room use for minimally invasive surgery from 1999 to 2010.

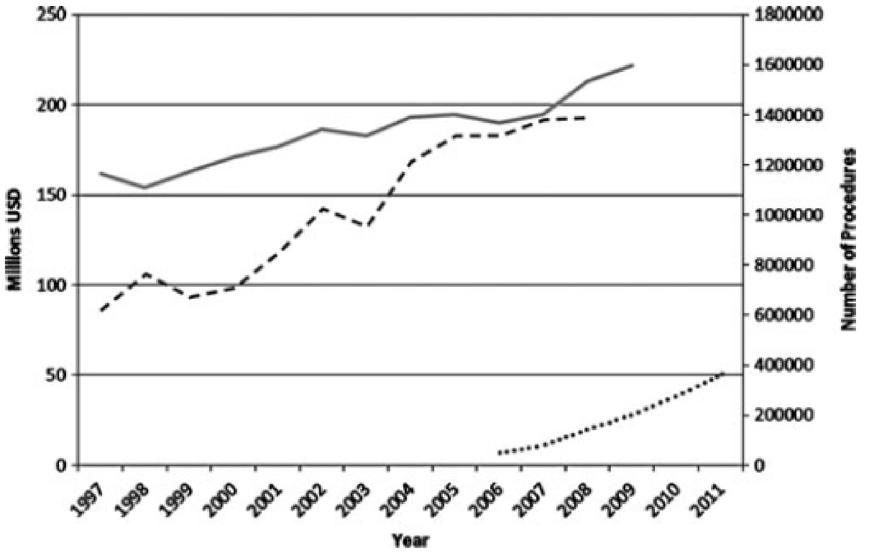


FIG. 2. Trends of United States yearly inpatient laparoscopic procedures (—), yearly robot- assisted procedures (.....), and carbon dioxide supplier's yearly U.S. medical packaged gas sales adjusted for inflation (- - - -).

Power et al. J Endourol, 2012

C02-Fußabdruck unterschiedlicher OP-Verfahren

Roboter-assistiert | Laparoskopie | Offen

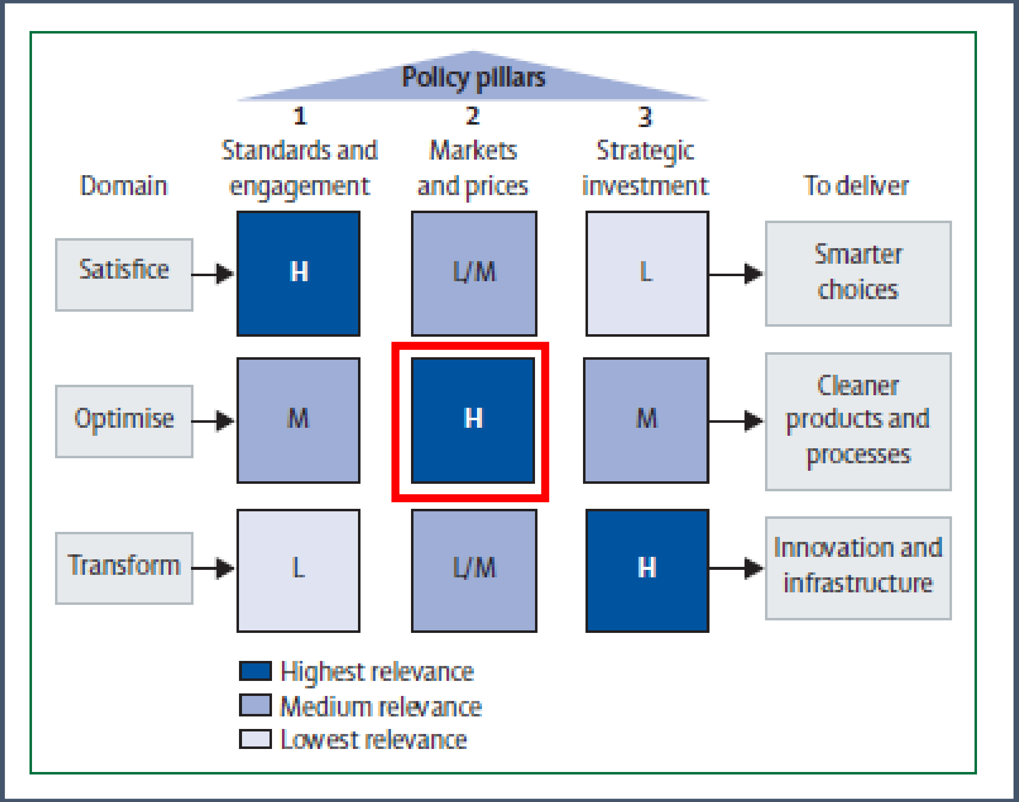
Table 2. Total kg CO_2e equivalents produced by surgical modality

	RA-LSC	LSC	LAP	All types	*p*
Energy kWh (SD)	49.6 (± 11.9)	33.95 (± 7.7)	27.41 (± 7.3)	36.98	< 0.01
Environmental (kWh)	26.68	29.08	26.19	27.31	
da Vinci (kWh)	20.30	–	–	–	
Equipment (kWh)	2.62	4.77	1.12	2.83	
Instrument (kWh)	0.00	0.1	0.1	0.06	
Operative time (min) (SD)	375.2 (± 92.96)	409.06 (± 90.6)	243.9 (± 65.07)	242.72	< 0.01
Energy CO_2 (kg)	26	18	14.4	19.46	< 0.01
Waste (kg)	14.3	11.2	8.3	11.26	
Infection control (kg)	4.03	1.60	1.60	2.41	
Single-use device (kg)	2.47	3.35	0.82	2.21	
Consumable (kg)	6.90	6.03	5.86	6.26	
Sterile wrap (kg)	0.88	0.99	0.44	0.77	
Waste CO_2 (kg)	14.3	11.2	8.3	11.26	
Total CO_2 (kg)	40.3	29.2	22.7	30.72	< 0.01

Woods et al. Int J Med Robotics Comput Assist Surg, 2015

Fazit

- Urologische Erkrankungen (benigne/ maligne) sind direkt von klimatischen Veränderungen abhängig
- Weitere Aspekte in der Urologie: Spüllösungen zur Harnblasenirrigation, Antibiotikaeinsatz, Schistosomiasis, …
- Interdisziplinäre Forschungsansätze → „Evidence Guidance“ → Transformation im Krankenhaussektor



Vielen Dank für Ihre Aufmerksamkeit

steffen.rausch@med.uni-tuebingen.de

www.uro-tuebingen.de

EBERHARD KARLS UNIVERSITÄT TÜBINGEN

Universitätsklinikum Tübingen

13.01.2022