Christian-Albrechts-Universität zu Kiel
Medizinische Fakultät

UNIVERSITÄTSKLINIKUM
Schleswig-Holstein

Infektionsprävention
-
Der Nutzen von Einwegprodukten und der Weg zur Nachhaltigkeit

Univ.-Prof. Dr. Mark Ellrichmann, MaHM
Universitätsklinikum Schleswig-Holstein
Campus Kiel

Hygieneforum Berlin
Berlin, den 15.12.2022

Agenda

- WHO-Strategie Patientensicherheit

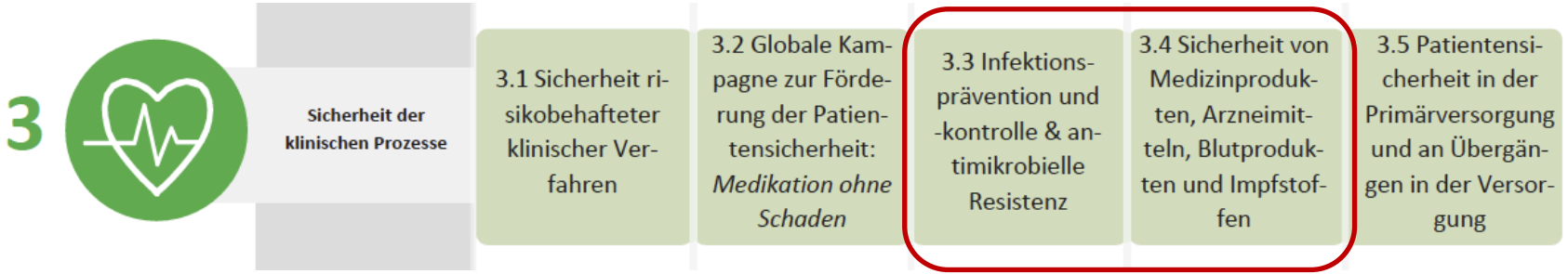
- Infektionsrisiko in der Endoskopie
- Infektionsprävention durch Einmalprodukte

- Problem: Müll und Medizin
- Maßnahmen zur Verbesserung der Nachhaltigkeit Endoskopie/Medizin

WHO-Strategie – Patientensicherheit

WHO global patient safety action plan;
https://www.who.int/teams/integrated-health-services/patient-safety/policy/global-patient-safety-action-plan

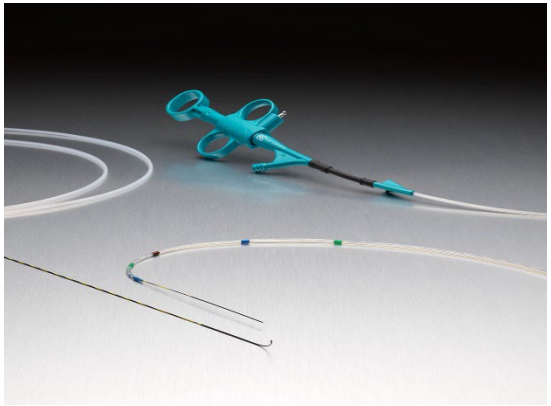
WHO-Strategie - Patientensicherheit



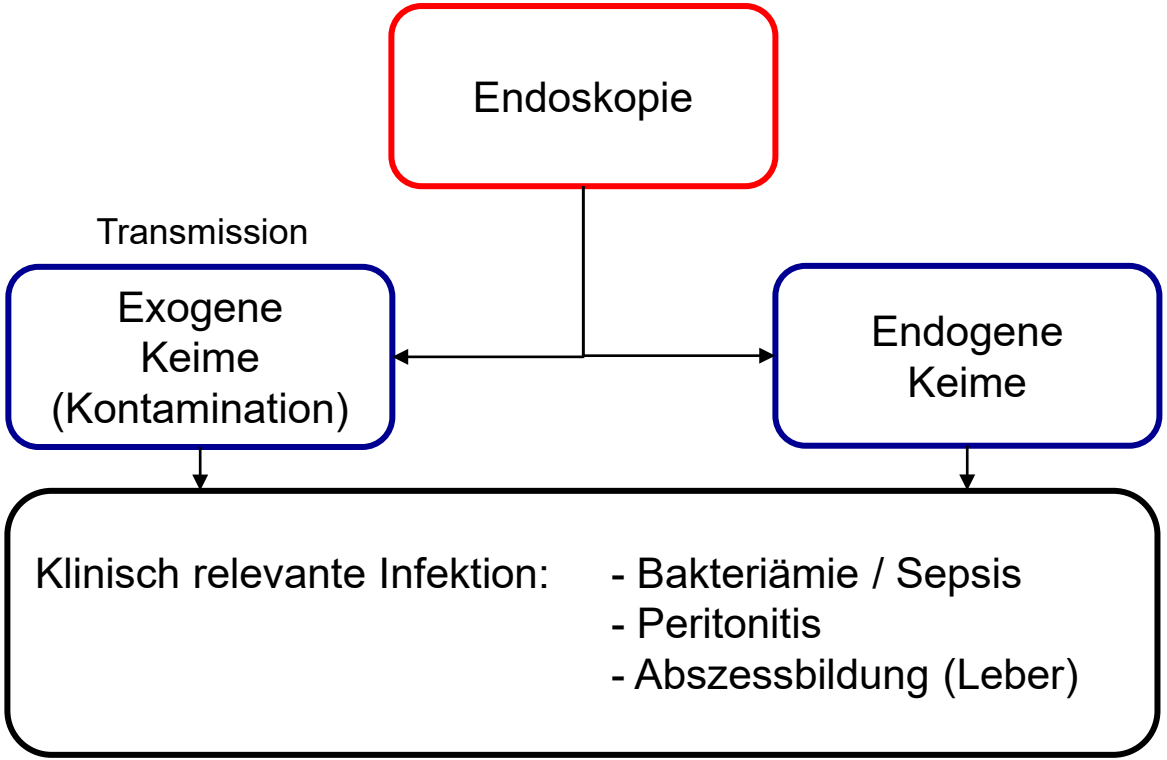
WHO global patient safety action plan;
https://www.who.int/teams/integrated-health-services/patient-safety/policy/global-patient-safety-action-plan

Infektionsrisiko in der Endoskopie

Infektionsrisiko in der Endoskopie – Standortflora und kleine Lumina



Infektionsrisiko in der Endoskopie – Kontamination vs. Infektion



Infektionsrisiko gastrointestinaler Endoskopien

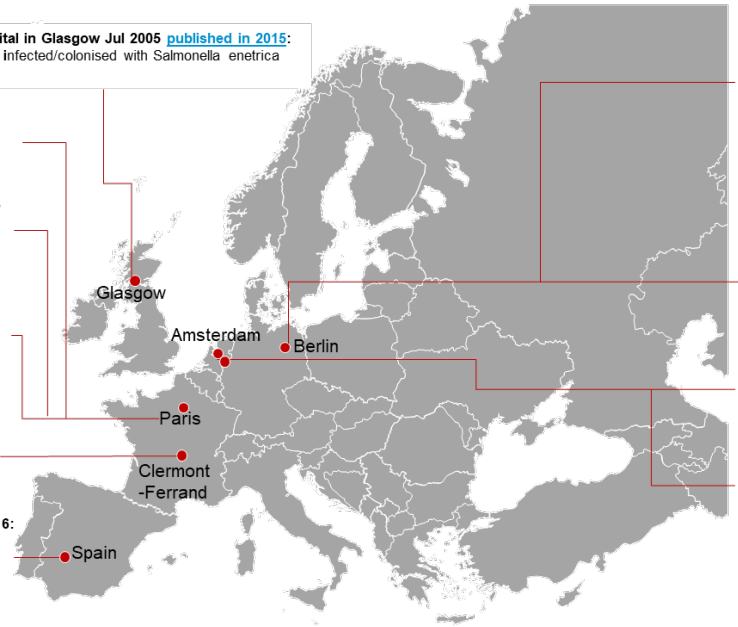
Microorganism	Endoscopic procedure	Contaminated patients, n	Infected patients, n	Infection(s)
Hepatitis B virus (HBV)	Upper GI endoscopy [9–11]	3	3	HBV infection
Hepatitis C virus (HCV)	1) Upper GI endoscopy [12]	9	9	HCV infection
	2) ERCP [13]		1	
	3) Colonoscopy [14,15]	3	3	
Salmonella spp	1) Upper GI endoscopy [18–22]	29	26	Bacteraemia/sepsis, gastroenteritis, urinary tract infection
	2) ERCP [23]		2	Sepsis, gastroenteritis
	3) Colonoscopy [18,24,25]	11	3	Gastroenteritis
Helicobacter pylori	Upper GI endoscopy [26–28]	4	4	Bacteraemia
Pseudomonas aeruginosa	1) Upper GI endoscopy [29–32]	114	13	Sepsis, cholangitis, pneumonia, lung abscess
	2) ERCP [29,33–46]	131	93	Bacteraemia/sepsis, cholangitis, cholecystitis, lever abscess, pancreatitis, urinary tract infection
Methylobacterium mesophilicum	ERCP [47]	1	1	Gastritis
Elizabethkingia meningoseptica	ERCP [48]	20	5	Sepsis, cholangitis

Microorganism	Endoscopic procedure	Contaminated patients, n	Infected patients, n	Infection(s)
Mycobacterium chelonae	ERCP [49]	14	0	No
Strongyloides stercoralis	Upper GI endoscopy [50]	4	4	Esophagitis
Trichosporon spp	Upper GI endoscopy [51,52]	10	1	Esophagitis

Reference	Microorganism	Endoscopic procedure	Contaminated patients, n	Infected patients, n	Infection(s)
Fraser 2004 [39]	*P. aeruginosa* (carbapenem-resistant)	ERCP	5	3	Sepsis, cholangitis
Kovaleva 2009 [2]	*P. aeruginosa* (carbapenem-resistant)	ERCP	3	3	Sepsis
Bajolet 2013 [55]	*P. aeruginosa* ESBL (TEM, SHV-2a, CTX-M)	Gastroscopy	4	3	Psoas haematoma pneumonia
Verfaillie 2015 [56]	*P. aeruginosa* CP (VIM-2)	ERCP	30	7 (4 infections within 1 year)	Positive clinical cultures (blood, abscess, endotracheal aspirate, pleural fluid, drain fluid)
Cooke 2006 [57]	*Klebsiella pneumoniae* ESBL	ERCP	13	13	Bacteraemia
Aumeran 2010 [58]	*K. pneumoniae* ESBL (CTX-M-15)	ERCP	16	12	Bacteraemia/sepsi cholangitis

Kovaleva et al. Best Pract & Research Clin Gastroenterol 2016

Infektionsrisiko – Fokus Duodenoskope / ERCP



Stobhill Hospital in Glasgow Jul 2005 published in 2015:
- **4 patients** infected/colonised with Salmonella enetrica (no MDR)

Clinique De Bercy in Charenton-le-Pont in Oct 2012 published in 2015:
- **3 patients** infected/colonised with Escherichia Coli

Clinique De Bercy in Charenton-le-Pont in Nov 2013 published in 2015:
- **2 patients** infected/colonised with Escherichia Coli

Multiple hospitals in Paris 2009, published in 2010:
- **8 patients** infected/colonised with Klebsiella pneumoniae (MDR)

Clermont-Ferrand in Dec 2008, published in 2010:
- **16 patients** infected/colonised with Klebsiella pneumoniae (MDR)

2009-2016 outbreaks, published as poster at DDW '16:
- **3 patients** with KPC-prod. K. pneum.
- **1 patient** with ESBL- E. coli
- **9 outbreaks** (non MDRO)
- **2 deaths**

Charite Universitätsmedizin Berlin Dec 2012 published in 2015:
- **8 patients** infected/colonised with Klebsiella pneumoniae

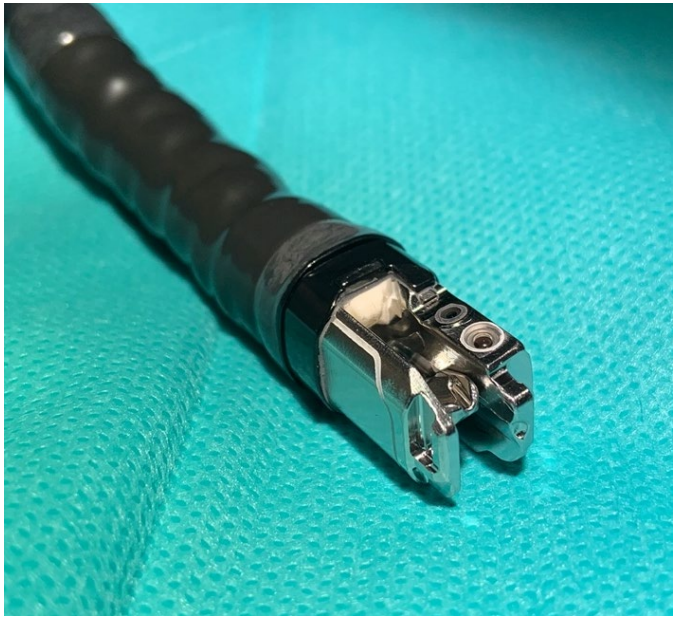
Evangelisches Waldkrankenhaus Spandau in Berlin May 2014 published in 2015:
- **4 patients** infected/colonised

Erasmus Medical Center in Rotterdam Jan 2012 published in 2015:
- **22 patients** infected/colonised with Pseudomonas aeruginosa (MDR)

Universitair Medisch Centrum in Utrecht Jan 2015 published in 2015:
- **>30 patients** infected/colonised (organism and resistance status not reported)

=> Infektionsrisiko durch ERCP/Duodenoskope => 0.4 – 1 %

Infektionsrisiko – Fokus Duodenoskope / ERCP



Kontaminierte Duodenoskope – FDA post market surveillance study

- Duodenoskope: Olympus, Fuji, Pentax
- Ziel: Evaluation vitaler Mikroorganismen nach HLD
- Hypothese: Kontaminationsrate der Duodenoskope < 0.4%

Kategorie der Bakterien	Cut of level CFU /20 ml	Kontaminationsrate
Geringes und moderates Risiko	> 100 CFU	3.6%
Hohes Risiko (E. coli, Pseudomonas aeruginosa)	> 100 CFU	6.1%

https://www.fda.gov/medical-devices/safety-communications/fda-continues-remind-facilities-importance-following-duodenoscope-reprocessing-instructions-fda

Kontaminierte Duodenoskope – Mikrobielle Analyse

- Definition der Kontamination

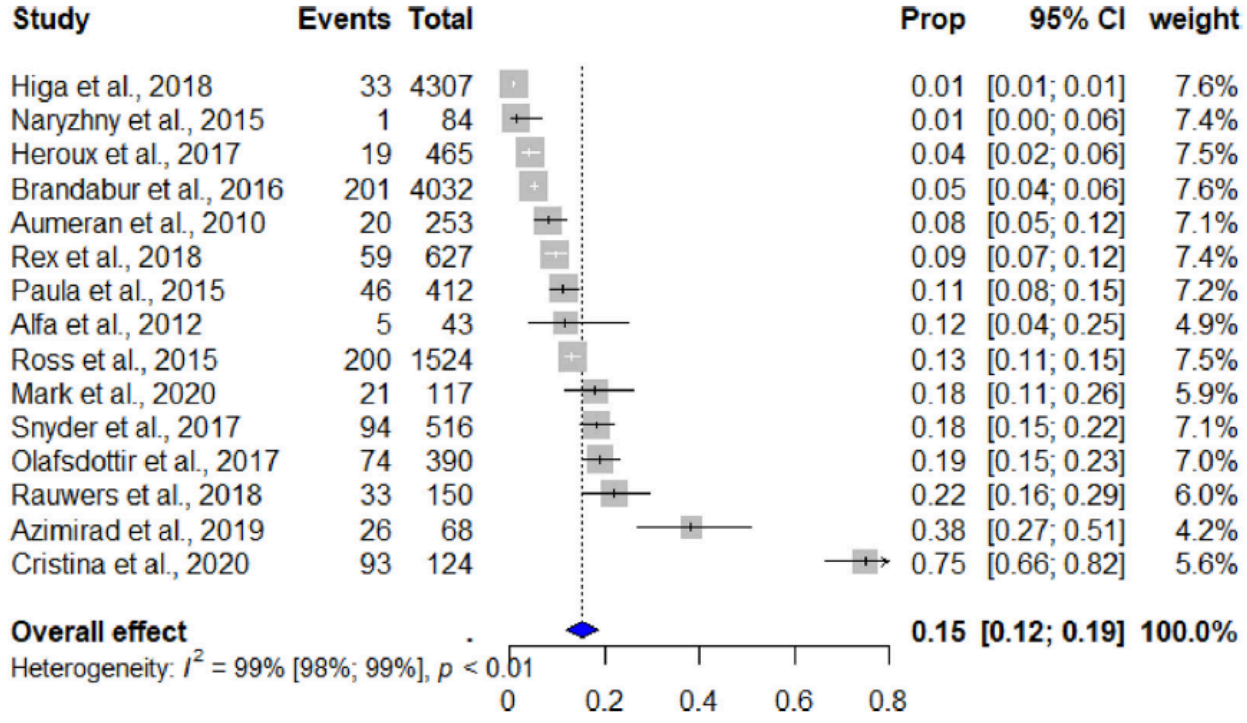
≥ 20 CFU /20 ml für alle Mikroorganismen

≥ 1 CFU /20 ml für MGO (Mikroorganismen Mundhöhle /GIT)

73	155	4 - 6	15%
Zentren	Getestete Duodenoskope	Areale Probennahme/ Duodenoskop	Kontaminationsrate nach HLD

Rauwers et al. Gut 2017

Kontaminierte Duodenoskope – Metaanalyse



Larsen et al. EClinicalMedicine 2020

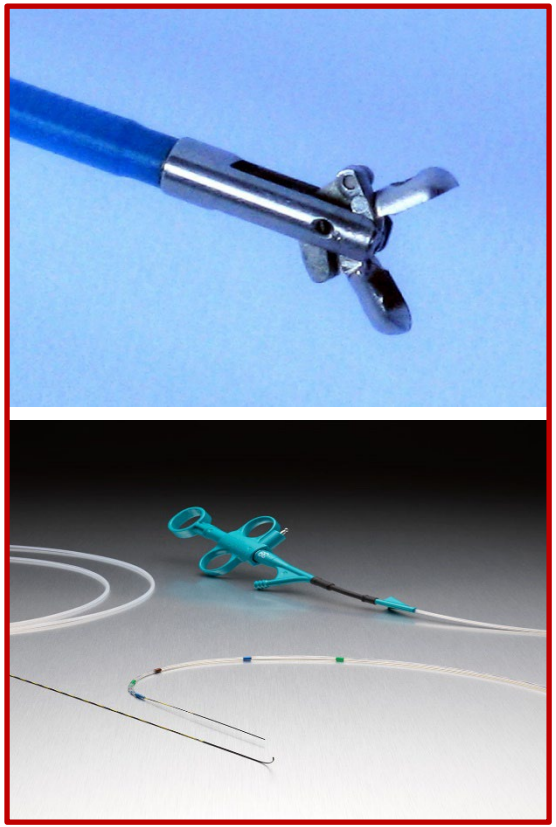
Agenda

- WHO-Strategie Patientensicherheit

- Infektionsrisiko in der Endoskopie
- Infektionsprävention durch Einmalprodukte

- Problem: Müll und Medizin
- Maßnahmen zur Verbesserung der Nachhaltigkeit Endoskopie/Medizin

Infektionsprävention in der Endoskopie

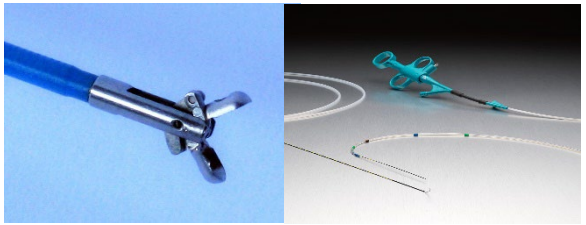


Infektionsprävention - Positionspapier – ESGE und ESGENA – Abschnitt 9.1

Position Statement

Thieme

Reprocessing of flexible endoscopes and endoscopic accessories used in gastrointestinal endoscopy: Position Statement of the European Society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastroenterology Nurses and Associates



Recommendation

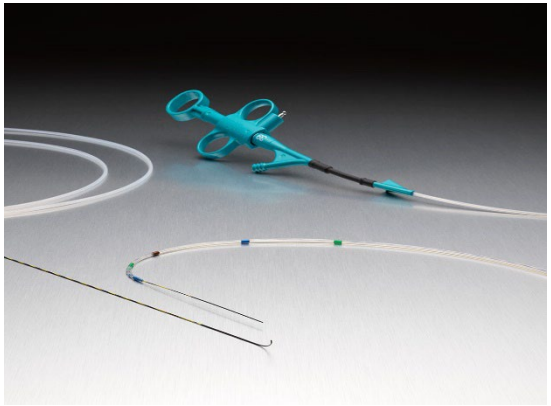
The employment of single-use endoscopic accessories whenever possible is strongly recommended.

Recommendation

Endoscopic accessories defined as single-use devices should be discarded directly after use.

Beilenhoff et al. Endoscopy 2018

Infektionsprävention in der Endoskopie



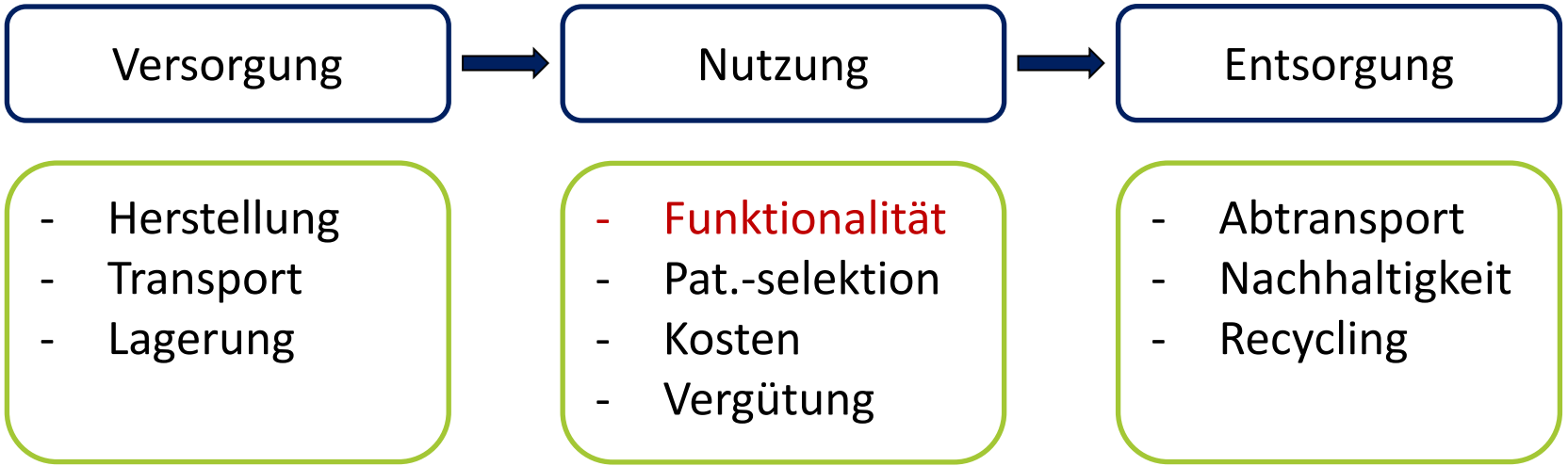
Infektionsprävention – Technische Möglichkeiten - Einmalendoskope

Duodenoskop	Cholangioskop	Gastroskop	Koloskop
Exalt Model D	SpyGlassDSII	aScope Gastro	aScope Kolo
aScope Duodeno	Briview	Boston Scient.	Boston Scient.
	Ambu		
	Microtech		

Stand, 05.12.2022

Infektionsprävention – Einmalduodenoskop – Beispiel Exalt Model D

Infektionsprävention - Zyklus der Einmal-Endoskope



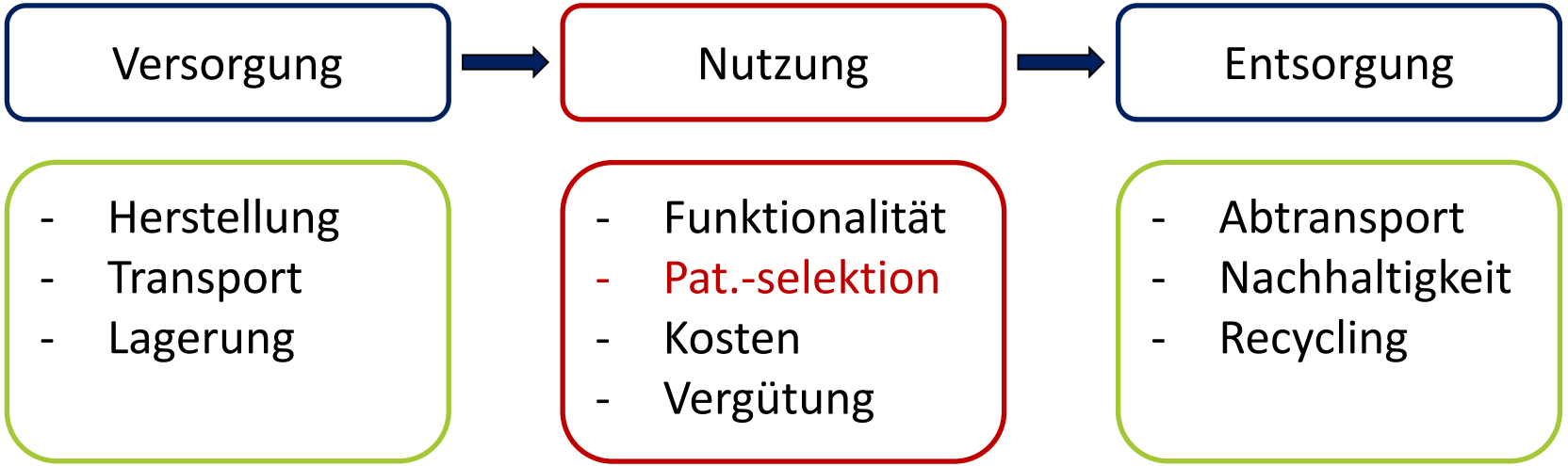
Funktionalität – Einmalduodenoskope – klinischer Einsatz

Ref.	Region, Study design	Population (no.); male gender (%)	Age (yr, SD)	Naïve papilla (%)	ASGE complexity 3-4 (%)	Technical success (%)	Serious AEs (%)	Note
Muthusamy *et al*[22], 2020	United States, Case-series	No. 60, Male 61.7%	64.4 ± 14.1	26.70%	45.00%	96.70%	6.70%	The study included a roll-in phase with 13 patients
Bang JY *et al* [23], 2020	United States, RCT	No. 48, Male 54.2%	67.2 ± 14.4	100%	16.70%	SUD: 95.8%; Reusable: 100%	4.20%	Primary outcome was no. attempts to achieve cannulation (SUD median 2; reusable 5; P = 0.013)
Napoléon *et al* [24], 2022	France, Prospective	No. 60, Male 43.3%	65.5 ± 13.6	53.30%	40.00%	95%	1.70%	96.7% of cases with optimal operators' satisfaction
Slivka *et al*[25], 2021	United States, Prospective	No. 200, Male 48.5%	62.6 ± 14.0	45.50%	40.50%	90.50%	6.50%	Included 14 expert and 5 "non-expert" ERCP operators with similar outcomes

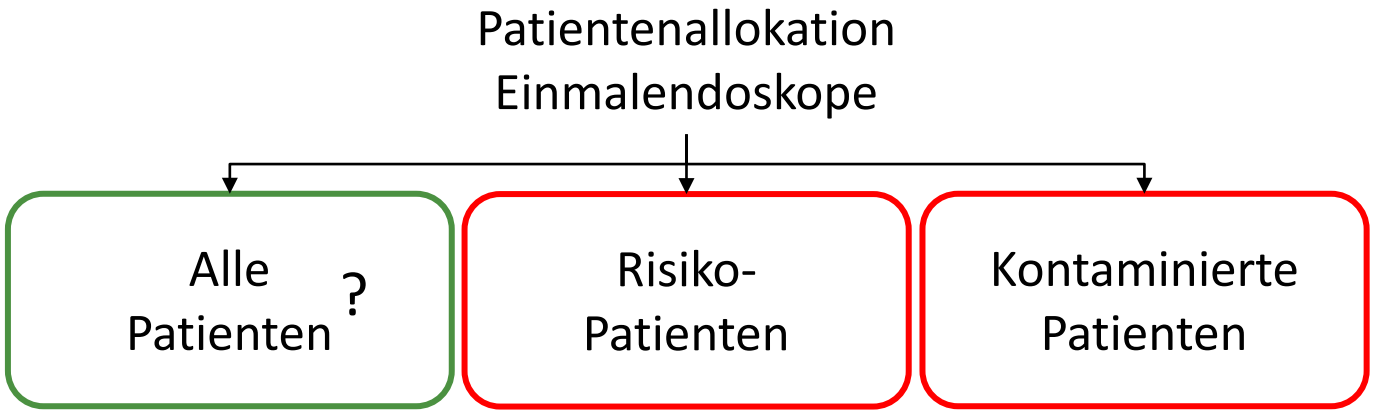
Technischer Erfolg ⌀ = 95 %

Lisotti et al. WJ Methodology 2022

Infektionsprävention - Zyklus der Einmal-Endoskope



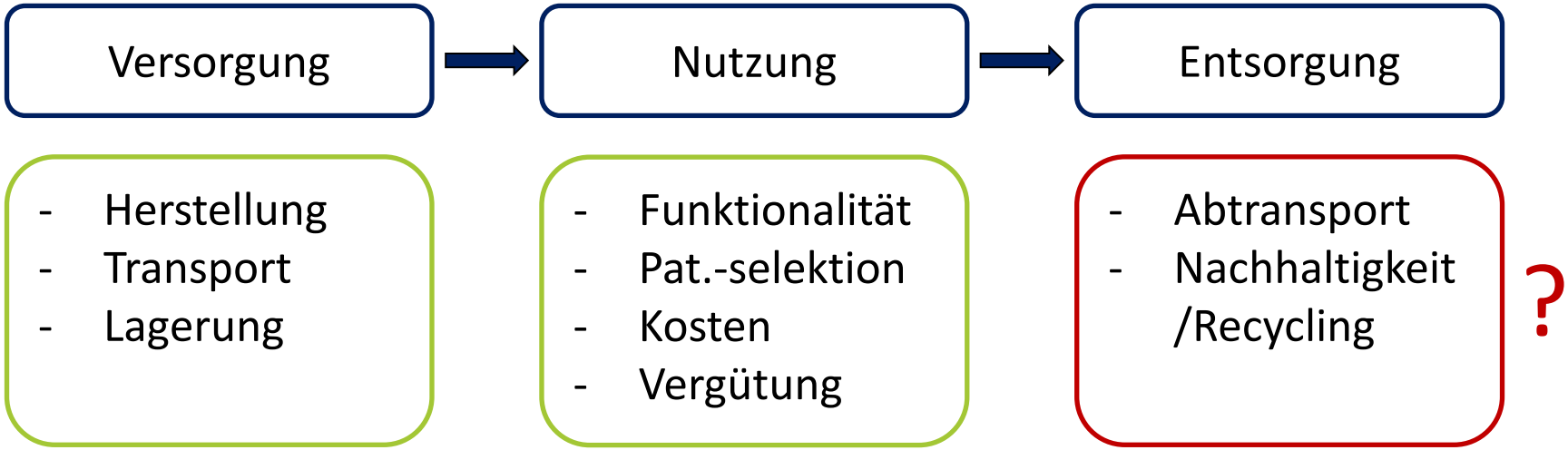
Infektionsprävention - Patientenallokation



- Transplantation
- Maligne Erkrankungen
- HIV -Infektion
- Immunsuppression

- MDRO
- SARSCoV2
- …

Infektionsprävention - Zyklus der Einmalmaterialien



Agenda

- WHO-Strategie Patientensicherheit

- Infektionsrisiko in der Endoskopie
- Infektionsprävention durch Einmalprodukte

- Problem: Müll und Medizin
- Maßnahmen zur Verbesserung der Nachhaltigkeit Endoskopie/Medizin

„Moderne Medizin macht Müll“

Spannungsfeld - Green Endoscopy vs. Patientensicherheit / Hygiene

≠

Circulus vitiosus - Green Endoscopy vs. Patientensicherheit / Hygiene

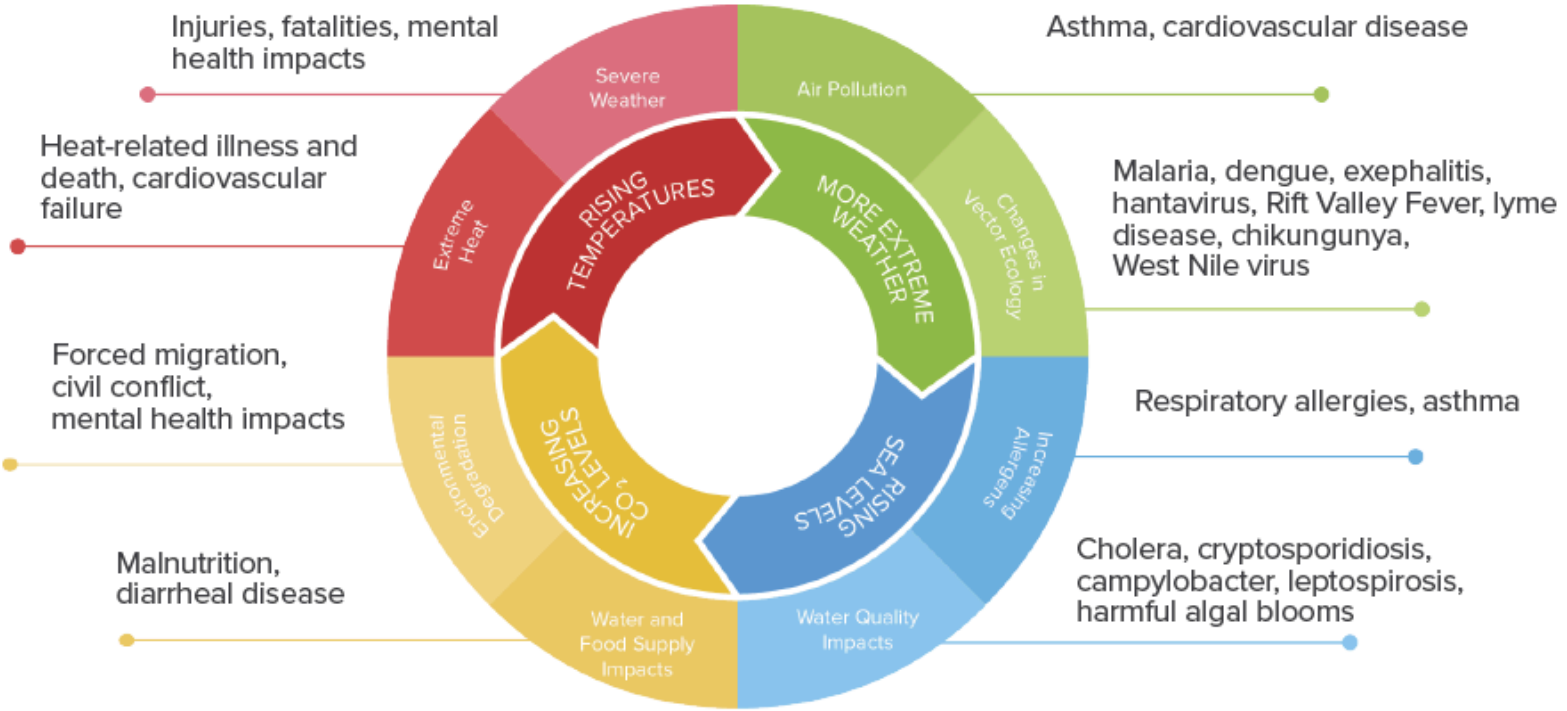


Bild: US Center für Disease Control and Prevention, 2021

Abfallmenge pro Endoskopie

	All	Low endoscopy volume centre	High endoscopy volume centre	Relative difference*
Endoscopic procedures per year, n	15 000	2000	13 000	6.50
Procedures performed during 5-day audit, n	278	37	241	6.51
Colonoscopies, n	135	21	114	5.43
EGD, n	112	10	102	10.20
ERCP, n	7	2	5	2.50
EUS, n	17	1	16	16.00
Sigmoidoscopy, n	7	3	4	1.33
Waste produced during 5-day audit†				
Volume, n trash bins (20 Ga or 76 L)	190	19	171	8.95
Mass, kg	619	73	546	7.51
Waste per endoscopy				
Volume, n bins (20 Gal or 76 L)	0.61	0.52	0.71	1.37
Direct landfill waste, n bins (%)	0.41 (67)	0.38 (74)	0.43 (61)	
Biohazard waste, n bins (%)	0.10 (17)	0.14 (26)	0.07 (10)	
Recycled waste, n bins (%)	0.10 (17)	0 (0)	0.21 (29)	
Volume, m^3	0.05	0.04	0.05	1.37
Mass, in kg	2.11	1.96	2.27	1.15
Direct landfill waste, kg (%)	1.34 (64)	1.33 (68)	1.36 (60)	1.03
Biohazard waste, kg (%)	0.59 (28)	0.64 (32)	0.54 (24)	0.85
Recycled waste, kg (%)	0.18 (9)	0 (0)	36 (16)	–
Waste of reprocessing one endoscope				
Volume, trash bins (20 Gal or 75 L)	0.07	N/A	0.08	–
Volume, m^3	0.005	N/A	0.006	–
Mass, kg	0.30	N/A	0.33	–

N/A, not available
*High vs low volume centre.
†Without reprocessing of endoscopes.
EGD, esophagogastroduodenoscopy; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound.

Namburar et al. Gut 2022

Abfallmenge – 18 Mio. Endoskopien in den USA

WASTE in VOLUME:
836,000 cubic meters

Equivalent to

Covering 117 soccer fields
with waste to 1 m depth

WASTE in WEIGHT:
38,100 metric tons*

Equivalent to

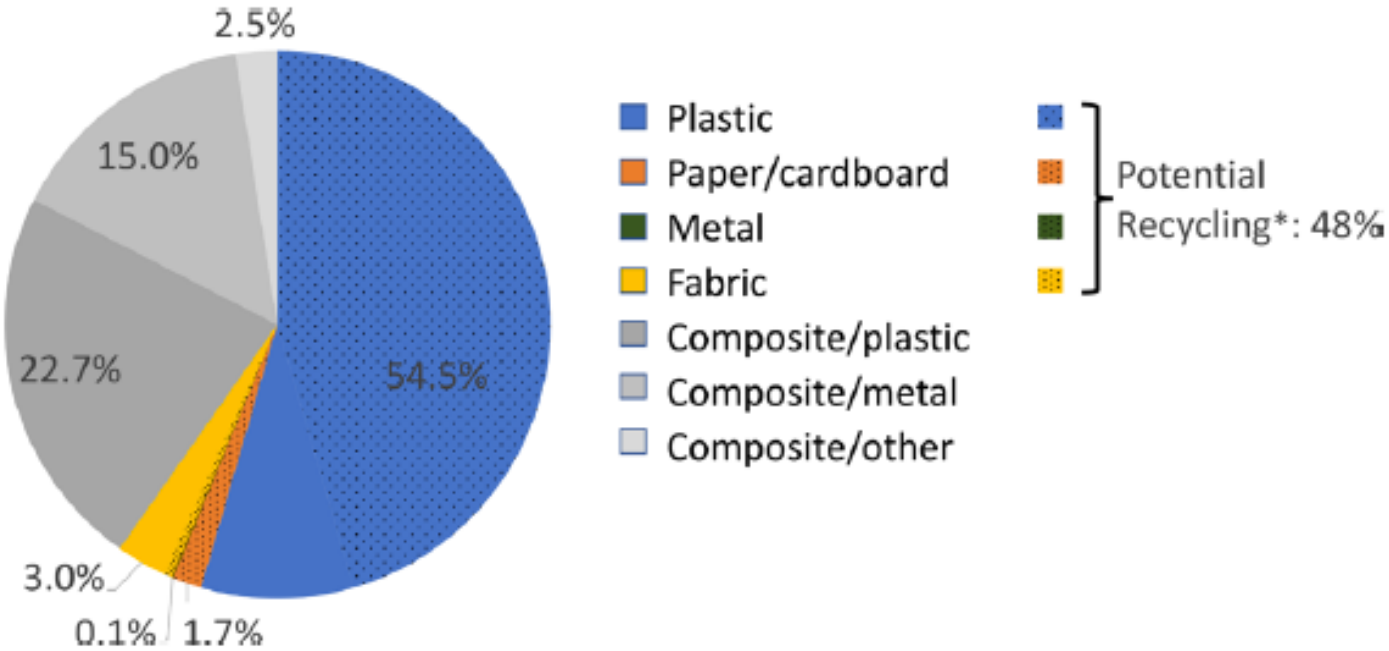
24,900 passenger cars

18 Mio Endoskopien:

- 11 Mio. Koloskopien
- 6.8 Mio ÖGD
- 170.000 ERCPs

Namburar et al. Gut 2022

Abfallmenge – Anteile der Einzelrohstoffe



Namburar et al. Gut 2022

Maßnahmen zur Erhöhung der Nachhaltigkeit in der Endoskopie

Reducing the environmental footprint of gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) Position Statement

3 Kategorien:

- Klinisches und endoskopisches Management
- Endoskopische Logistik - Prozessmanagement
- Einmalprodukte

Rodriguez et al. Endoscopy 2022

Maßnahmen zur Erhöhung der Nachhaltigkeit in der Endoskopie

	Clinical and endoscopic management
1	ESGE-ESGENA recommend adopting immediate actions to reduce the environmental impact of GI endoscopy.
2	ESGE-ESGENA recommend adherence to guidelines and implementation of audit strategies on the appropriateness of GI endoscopy, to avoid the environmental impact of unnecessary procedures.
3	ESGE-ESGENA recommend a rational use of periprocedural and intraprocedural medication to reduce the environmental impact of GI endoscopy.
4	ESGE-ESGENA recommend using low-waste, less invasive alternatives to endoscopy (e. g., fecal calprotectin, urea breath test, etc.) within the bounds endorsed by evidence-based clinical guidelines.
5	ESGE-ESGENA suggest that digitalization, telemedicine, and efficient clinical pathways may reduce the environmental impact of pre- and post-procedural GI endoscopy-related health care.
6	ESGE-ESGENA suggest that diagnostic strategies that safely reduce the number of samples sent for histological analysis can reduce the environmental impact. This can be achieved via optical diagnosis and adherence to guidelines on the indications for endoscopic tissue sampling.
7	ESGE-ESGENA recommend considering the environmental impact when selecting the appropriate endoscopic technique. The less resource-intensive technique should be favored, provided efficacy and safety are maintained.
8	ESGE-ESGENA recommend a rational use of endoscopic accessories during the procedure.
9	ESGE-ESGENA suggest performing most elective endoscopic procedures on an outpatient basis to avoid overnight hospital stays and hence reduce the environmental impact.

Rodriguez et al. Endoscopy 2022

Maßnahmen zur Erhöhung der Nachhaltigkeit in der Endoskopie

Endoscopy logistics	
10	ESGE-ESGENA recommend applying the principles of sustainable architecture to the design and construction of GI endoscopy units.
11	ESGE-ESGENA suggest implementing an accreditation process for GI endoscopy units that embraces sustainability.
12	ESGE-ESGENA recommend favoring the use of renewable energy at GI endoscopy units. This goal should be achieved in the context of local and national policies.
13	ESGE-ESGENA recommend the embedding of reduce, reuse, and recycle programs in the GI endoscopy unit.
14	ESGE-ESGENA recommend revisiting waste management in the GI endoscopy unit to ensure adequate segregation and processing policies. The 3 R (Reduce-Reuse-Recycle) and circular economy principles should be the core of these policies.
15	ESGE-ESGENA recommend the digitalization of the GI endoscopy unit (including electronic reporting), minimizing paper printing, and using energy-efficient endoscopy and electronic devices.
16	ESGE-ESGENA recommend establishing local protocols and environmental educational programs for personnel to practice in an environmentally friendly and sustainable way.
Single-use accessories	
17	ESGE-ESGENA recommend that future clinical guidelines and regulations on GI endoscopy reprocessing/disinfection should consider the environmental impact of these practices and that of single-use devices.
18	ESGE-ESGENA suggest that there is an urgent need to reassess and reduce the environmental and economic impact of single-use GI endoscopic devices. GI and endoscopy societies should collaborate with industry to minimize the environmental burden of single-use devices.
19	ESGE-ESGENA suggest using GI endoscopy devices that have an environmentally sustainable design (e. g., reloadable clips or band ligators).

Rodriguez et al. Endoscopy 2022

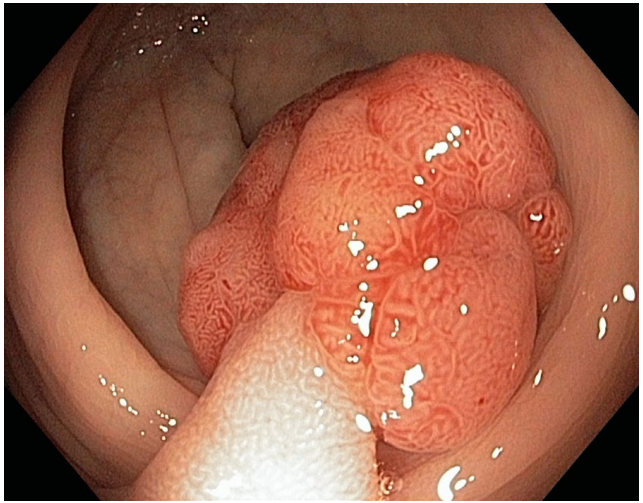
Maßnahmen zur Erhöhung der Nachhaltigkeit in der Medizin / Endoskopie

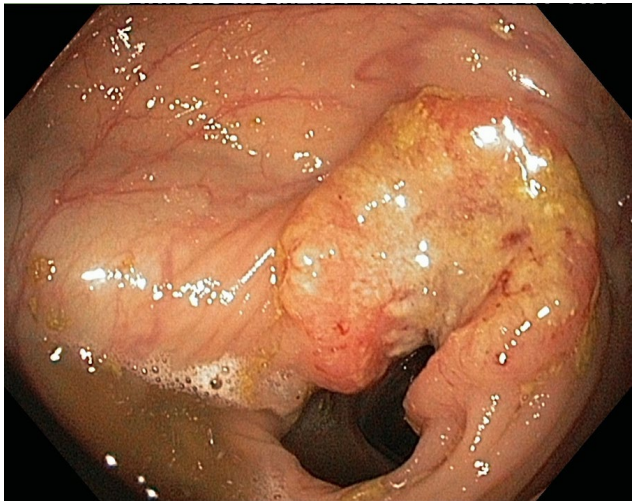
WHO Waste hierarchy model, 2022; http://who.int

Maßnahmen zur Erhöhung der Nachhaltigkeit in der Medizin / Endoskopie

Prävention:

- Darmspiegelung kann Darmkrebs vermeiden





Maßnahmen zur Erhöhung der Nachhaltigkeit in der Medizin / Endoskopie

WHO Waste hierarchy model, 2022; http://who.int

Maßnahmen zur Erhöhung der Nachhaltigkeit in der Medizin / Endoskopie

Recycling

- Geschlossener Kreislauf für die Herstellung und Nutzung von Medizinprodukten

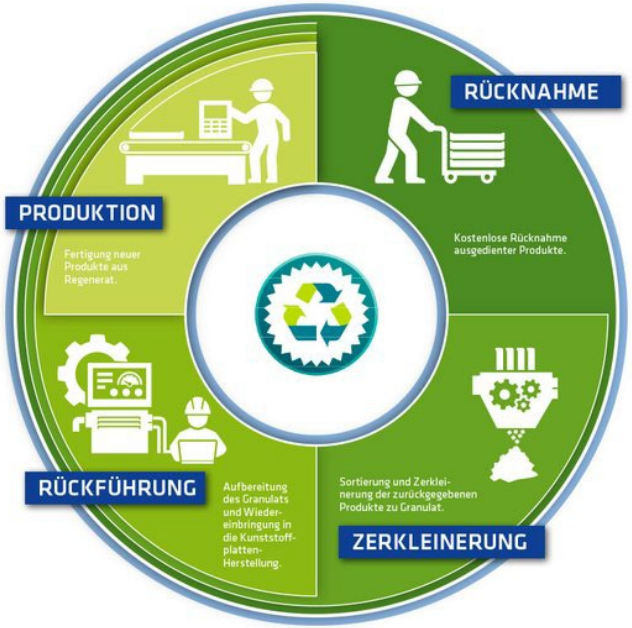
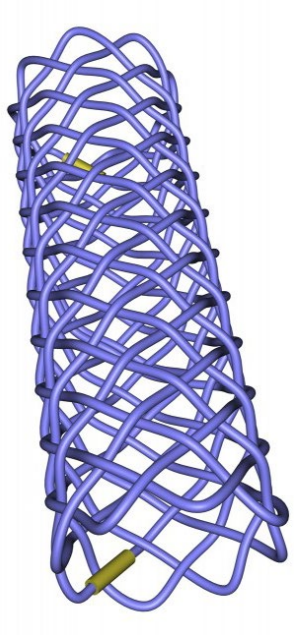


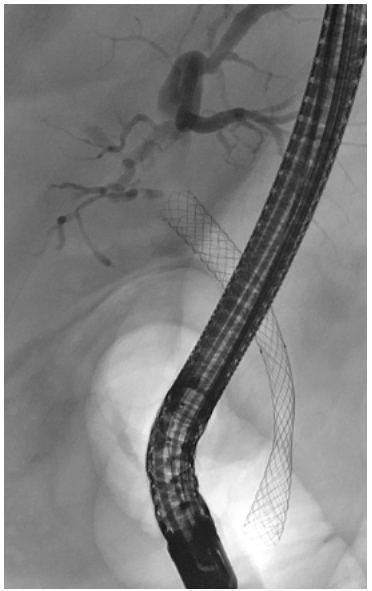
Bild: Söhner Kunststofftechnik GmbH

Maßnahmen zur Erhöhung der Nachhaltigkeit in der Medizin / Endoskopie

Recovery

- Entwicklung neuer biodegradierbarer Medizinprodukte / Verpackungen

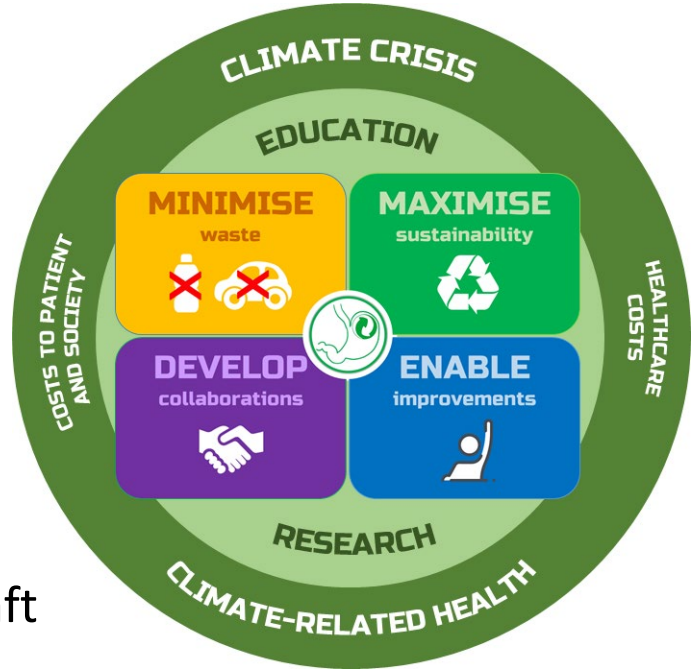




https://ellacs.cz/en/dv-stent-biliary

Enge Kooperation zwischen Fachdisziplinen

Medizin



Politik

Industrie
- Medizinprodukte
- Entsorgung

Wissenschaft
- Medizin
- Materialentwicklung

Univ.-Prof. Dr. Mark Ellrichmann, MaHM
Universitätsklinikum Schleswig-Holstein
Campus Kiel
mark.ellrichmann@uksh.de