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CME ARTICLE

Sustainability of dermatological offices and clinics: challenges and potential solutions

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Summary
Ongoing high consumption of resources results in exceeding the planetary boundaries. Modern healthcare systems contribute to this problem. To address this issue, this article provides an overview of various aspects of sustainable actions in medical offices and clinics that can also be applied to dermatology. Specific fields of action include energy consumption, structural measures, traffic and mobility, organization including digitalization as well as personnel and evaluation. Moreover, we discuss specific topics such as hygiene and cleansing, dermatosurgery and prescription practices. External treatments and cosmetics are discussed separately as dermatological peculiarities. Finally, we provide information on established initiatives for more sustainable health care in Germany. We aim to encourage critical reappraisal of currently established practices and to stimulate the implementation of sustainable measures.

KEYWORDS
climate change, energy efficiency, planetary boundaries, prescription practices, sustainability

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INTRODUCTION AND OVERVIEW ON THE SUBJECT OF SUSTAINABILITY

Fossil energy sources (such as brown coal, black coal, mineral oil and natural gas) are used on a large scale for energy production. During this process, carbon dioxide (CO_2) is produced; this gas is a major cause of the anthropogenic greenhouse effect and contributes to climate change. However, the increase of CO_2 concentrations in the atmosphere is only one of the planetary boundaries. These are theoretical thresholds that might result in severe disruption of the global ecosystem if they are exceeded;[1] examples are excessive use of water and land and the release of certain substances into the environment (Figure 1). Individual countries and humanity in general regularly exceed the limits of planetary boundaries before the end of a calendar year; this date is called "Earth overshoot day". However, adherence to these calculated limits is considered the prerequisite for a permanently functional balance between the evolution of humanity on the one hand and a functioning global ecosystem on the other hand.[2] As a supplement to the original designation of the planetary boundary "chemical pollution", the terminology of "novel entities" was added in recent years, given that their excessive synthesis threatens the global ecological balance. The release of plastic into the environment is considered to be a severe ecological problem.[3]

Individual countries and humanity in general regularly exceed the limits of planetary boundaries before the end of a calendar year; this date is called "Earth overshoot day".

The term 'sustainability' refers to measures regarded as beneficial for preservation of ecosystems in relation to one or several planetary boundaries. In a broader definition, 'sustainability' describes a development that takes ecological, economical, and social requirements equally into account. This is also referred to as a triple bottom line. While the terminology is in a constant state of flux,[4,5] the triple bottom line will suffice as a definition for sustainability in this article, since it can be considered as the basis for equal opportunities for subsequent generations (intergenerational justice).

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The healthcare sector is responsible for approximately 5% of global CO_2 equivalents.

The healthcare sector is responsible for approximately 5% of global CO_2 equivalents; a similar number has been calculated for Germany.[6–8] Accordingly, on the *125th Deutscher Ärztetag* in 2021, it was stated that climate protection should be integrated into the everyday actions of medical organizations in addition to their professional commitment (resolution:[9]). Accordingly, all expert groups were asked to establish measures for the reduction of emissions. In 2022, this appeal was emphatically renewed (online report *Deutsches Ärzteblatt*:[10]). In the United States, comparable appeals have been made by members of the *National Academy of Medicine*.[11] Based on these appeals, this article aims to outline ways toward more climate protection and sustainability in dermatology offices and clinics by providing specific and practice-oriented examples.

FRAMEWORK FOR A SUSTAINABLE HEALTHCARE IN GERMANY

The World Health Organization (WHO) defines a framework that can be related to medical facilities worldwide depending on country-specific conditions.[12] Potential approaches for sustainable intervention are presented in numerous individual aspects and subdivided as follows:

1. Personnel
2. Water, waste water, hygiene, and waste management
3. Sustainable energy
4. Infrastructure, technology, and products

Considering the Central European healthcare system and the specific local conditions, a pioneering work of Weisz et al. should be mentioned.[13] The authors report not only a calculation of the total emissions in Austrian healthcare, but also mention CO_2 equivalents for subsections of care. These

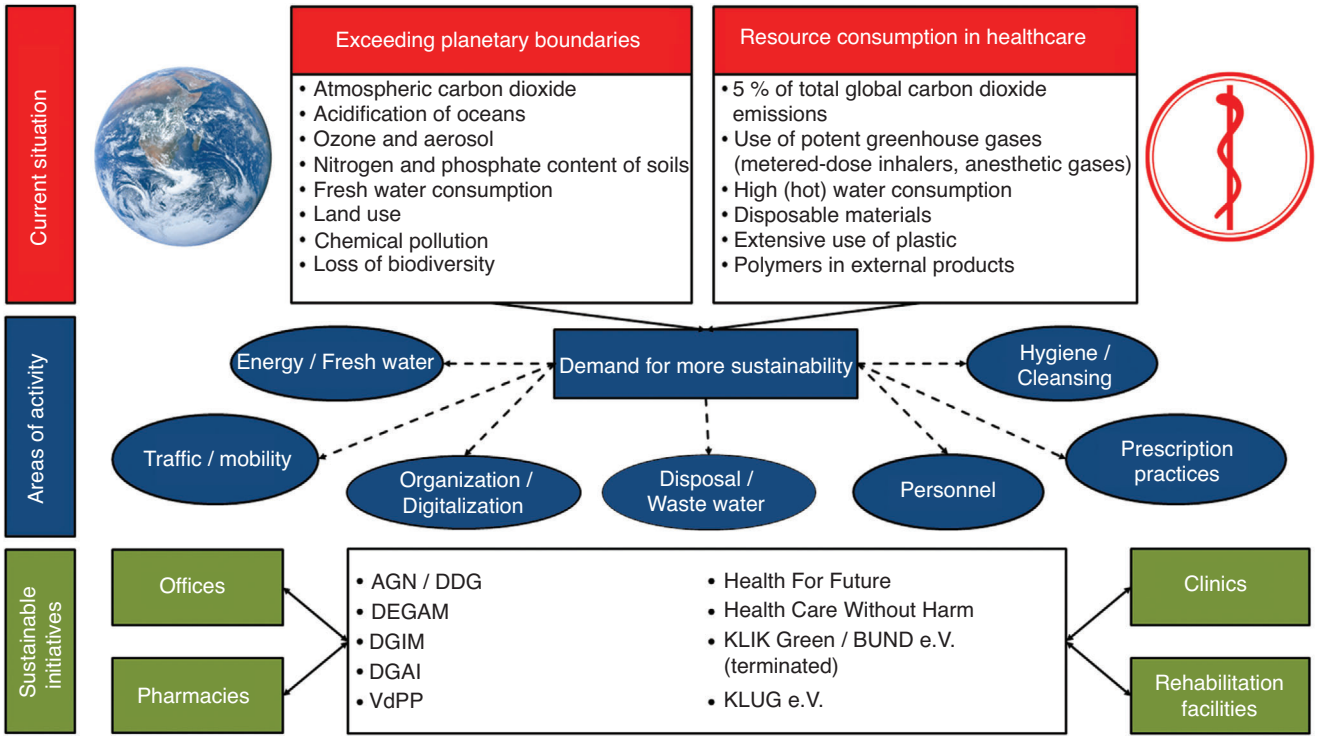

FIGURE 1 Conceptual diagram. The current situation is defined by continued exceeding of planetary load limits and high consumption of resources within the medical field. This results in the need for more sustainability of routine care in numerous fields of action. In addition to medical practices and clinics, sustainable initiatives from various specialist areas also address other medical facilities such as pharmacies and rehabilitation facilities. *Abbr.:* AGN/DDG: Arbeitskreis Nachhaltigkeit in der Dermatologie der Deutschen Dermatologischen Gesellschaft; DEGAM, Deutsche Gesellschaft für Allgemeinmedizin und Familienmedizin; DGIM, Deutsche Gesellschaft für Innere Medizin; DGAI, Deutsche Gesellschaft für Anästhesie und Intensivmedizin; VdPP, Verein demokratischer Pharmazeutinnen und Pharmazeuten; KLUG e. V., Deutsche Allianz Klimawandel und Gesundheit; KLIK Green BUND e. V., Projekt Klimaschutz in Kliniken Bund für Umwelt und Naturschutz Deutschland (terminated in 04/2022). Image copyright: earth (left), NASA, Public domain, via Wikimedia Commons; Rod of Asclepius (right), Ellywa at Dutch Wikipedia, Public domain, via Wikimedia Commons

calculations may aid in the prioritization of sustainable activities. Overall, hospitals were identified as the largest emitter of CO_2. In the inpatient sector, the purchase of medical products and services took up the largest share with 36% of CO_2 equivalents, while direct energy consumption (31%) and drugs (19%) followed. In the outpatient sector, consumables and drugs accounted for the largest portion of CO_2 equivalents. However, travel (especially for necessary repeated treatments) represents a larger item when compared to travel associated to inpatient care. In the pioneer article,[13] six general areas of action are defined that can reduce the effects of climate change (mitigation) and may in part apply to Germany:

1. Direct energy consumption (e.g. heating and electricity)
2. Use of product alternatives (e.g. equivalent products with less CO_2 emissions)
3. Avoidance of inefficiency in the healthcare system (including rational use of drugs)
4. Changes in medical treatments
5. Changes in national planning of healthcare
6. Transformation of the healthcare system to promote human health and planetary stability

The overall context of sustainable transformation should not only consider clinics and offices; adjacent areas of healthcare also deserve adequate attention (e.g. pharmacies, nursing homes and dialysis facilities). Since medical facilities usually consist of several subdivisions, a coordinated approach is expedient after analysis of the current situation. For this purpose, it is recommended to appoint responsible individuals (sustainability representative, climate manager) or to establish committees in larger facilities. The project *KLIK Green* (Klimamanager für Kliniken [Climate Manager for Clinics]) was funded by the German Federal Ministry for the Environment from 2019–2022 and provides a practical guide for this task. Projects already conducted at numerous locations can be retrieved from a database and used as a source of inspiration (internet link:[14]).

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For this overview article, we have used the outline presented in Table 1. Potential fields of action in a

TABLE 1 Practical aspects for a more sustainable management of medical offices and clinics. These recommendations are subject to a continuous process of development, completeness is not claimed. The table is modified according to "Tipps für eine nachhaltige Praxis" of the DGIM (www.dgim.de/ueber-uns/hausaerztliche-internisten) and "Klimaneutrale Praxis" of KLUG e. V. (www.klima-gesund-praxen.de/klimaneutrale-praxis)

Energy- and building-related aspects

Saving of electricity, (hot) water, and heating energy will conserve resources and is cost-efficient.

Electricity

- Avoidance of stand-by mode, switchable socket strips, use of small devices with rechargeable battery mode
- Lighting with light-emitting diodes (LEDs)
- Inspection of older electric devices, investments in energy-saving devices of newer generation
- Refrigerator temperature of 8°C is sufficient and saves energy, adjustment to the minimum requirement of medication requiring cooling
- Reduce use of dryer
- Instead of air conditioning: insulation and shading with sustainable materials, greening of facades and roof
- Avoid energy consumption in unused rooms, consider times of day, motion detectors
- Green electricity, photovoltaic system

Water

- Water-saving fittings and rinsing systems, flow aerators (perlators), automatic water shut-off
- Use of cold water at washbasin

Heating/Cooling

- Keep radiator free, ensure air circulation, maintain heating system regularly
- Programmable thermostats, downregulate as much as possible (recommendation: room temperature of max. 20°C)
- Wide opening of windows for a short time with switched-off heating; avoid tilted position of windows
- Sealing of any leaks on doors and windows

Traffic and mobility

- Ways to work by foot, bicycle, or public transport, carpools, creation of adequate infrastructure (e.g. bicycle stands)
- Employee bonuses: e.g. "job tickets", vouchers for bicycle repair
- Company bicycles, company car with electric drive (funding programs)

Office organization

- Climate-neutral shipment of direct mail
- Use of climate-friendly software providers: search machines (e.g. www.ecosia.de), email addresses (e.g. name@posteo.de), CO_2 compensation of the homepage
- Sustainable finance organization: banks, insurances, health insurance companies, investment in sustainable areas

Purchase and equipment

- The website www.siegelklarheit.de of the German government provides information about environmental protection seals such as "Blauer Engel". This is a benchmark for the sustainability of utility objects
- Prefer office material from sustainable providers, use of recycled products
- CO_2 neutral purchase of eco-friendly working clothes

Medical supply and promotional material

- Sustainable new acquisitions such as office furniture (material, country of origin, supply chain)
- Renovation measures with sustainable materials (e.g. wall paints)
- Service providers with sustainability standard
- Recycling paper for couch (no composite materials), disposable towels and sanitary facilities
- Economical use of disposable material and switch to recyclable materials, if possible (for example, kidney dishes)
- Reduction of product samples
- Cancellation of unnecessary magazines and promotion materials

Digitalization

- Digitalization of patient records and work processes (such as appointments and transmission of findings): saving of paper
- Opportunities of medical consultations with digital tools
- Teledermatology: saving of travels by patients, reduction of home visits
- Online meetings/hybrid events allow for medical training with reduced travel activity
- Smart-home technologies for targeted energy control on weekends and holidays

Hygiene and cleansing

- Alcohol-based hand disinfection
- Surface disinfections with as eco-friendly preparations as possible (little evidence)
- Minimize office laundry
- Establish material processing as opposed to disposable products

Prescription practices and drugs

- Adjust prescribed amounts, avoid polypharmacy
- Prefer dry powder inhalers over metered-dose inhalers, if possible
- Reject drug samples
- Intensified cooperation with pharmacists

(Continues)

TABLE 1 (Continued)

Disposal and waste management

- Establish multiple-use and upcycling systems
- Office mergers for ordering reduce packaging waste
- Proper drug disposal according to municipal regulations (www.arzneimittelentsorgung.de)

Employees

- Team meetings and training courses on the subject of sustainability
- Identification and collective implementation of sustainable activities as continuous team assignment, creation of notification system with sustainable ideas
- Process optimizations offer opportunities for increased satisfaction of employees and patients

Evaluation and quality management

- Introduction of quality management templates for sustainable measures (www.agderma.de)
- Regular evaluation for identification of progress and obstacles to make additional optimizations
- CO_2 emissions can be calculated by the ConClimate climate calculator for medical offices. Compensation can be made via climate protection projects like atmosfair, Klima-Kollekte or Primaklima

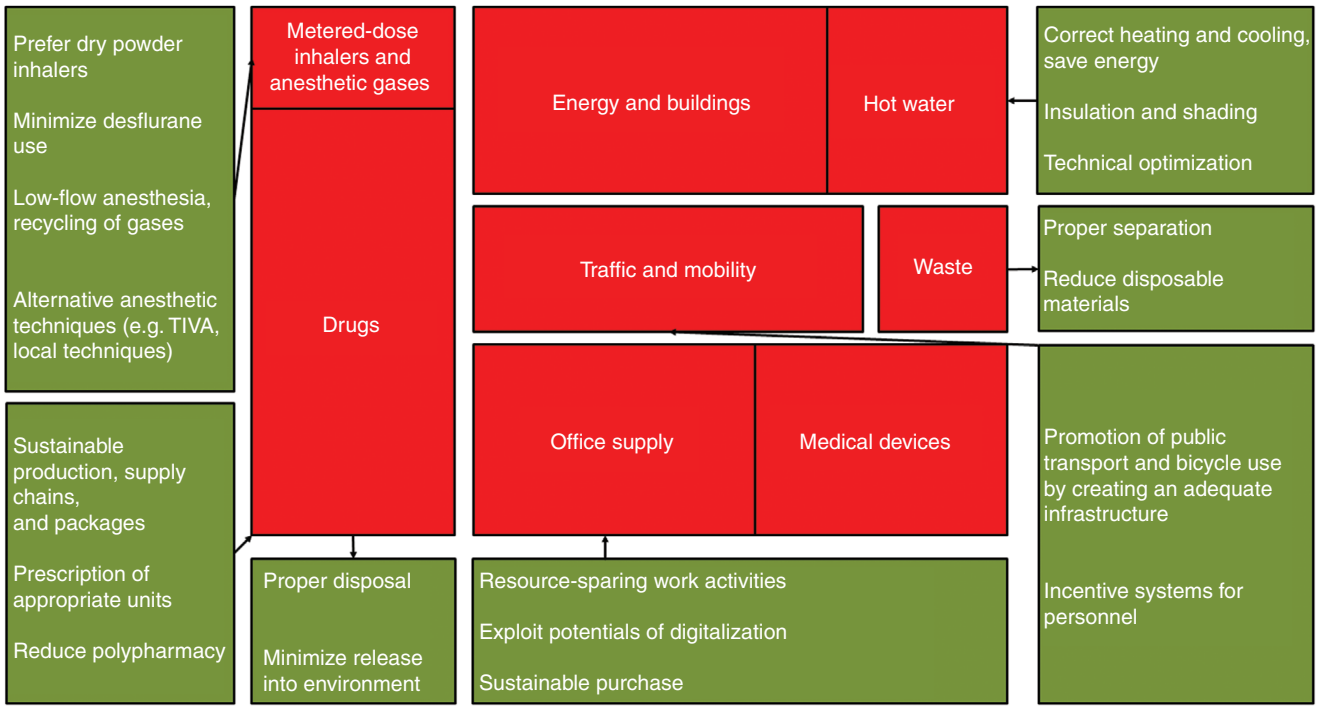

FIGURE 2 Estimated CO_2 footprint of medical offices (red squares), adapted according to data of the National Health Service (NHS).[15] Potential fields of action to improve sustainability are mentioned in the marginal columns, see Table 1. *Abbr.:* TIVA, total intravenous anesthesia; CO_2, carbon dioxide

dermatological office are presented concisely in Figure 2. In addition, economical aspects will be outlined, since these may be a major obstacle to sustainable transformation.

ENERGY-RELATED AND BUILDING-RELATED ASPECTS

Since the energy sector accounts for a significant proportion of emissions from buildings, numerous political instruments to promote energy efficiency have already been developed in Germany, although their efficacy is, in part, subject to controversial debate. However, it is evident that energy consumption accounts for a very substantial component of CO_2 emissions in both inpatient and outpatient sectors.[15] In a recent analysis of CO_2 emissions of ten private primary care practices in Switzerland, heating energy was identified as the second largest item.[16] Structural measures may include the promotion of natural ventilation and natural light sources, installation of energy-efficient (ideally natural) insulation materials, and environmental design (for example greening of roofs and facades). Implementation may be challenging, because it is often impossible to close facilities of the healthcare system

and their continuous operation has to be ensured. In addition, rental arrangements may be in conflict with structural measures. However, apart from these expensive structural interventions, easily achievable measures to conserve electricity and water may be economically useful.[17]

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ELECTRICITY CONSUMPTION

Unnecessary consumption of electricity should be identified and avoided as much as possible. Like private households, electrical devices with a stand-by mode (such as monitors) can be switched off by using socket strips or time switches. Energy-efficient light sources should be used for lighting; in less frequented areas, installation of motion detectors is recommended.

Electricity consumption of modern light-emitting diodes is up to 60% lower than in older light sources.

Electricity consumption of modern light-emitting diodes is up to 60% lower than in older light sources (internet link:[18]). With regard to energy consumption, many electric devices of older generations are also inefficient. In this respect, a new acquisition may pay off after a few years. However, the overall ecological balance may differ in individual cases, because consumption of resources during the production of new instruments should be taken into account. With regard to refrigerators, unnecessarily low temperatures should be avoided, because these result in disproportionately high energy consumption compared to the minimum requirements for the cold chain. Since at present a relevant portion of electricity production in Germany is based on burning fossil fuels, the purchase of "green electricity" should be considered "common web-based tools may identify suitable rates". The purchase of a photovoltaic system may also have a positive effect on the energy balance of a medical facility. Economic and taxation effects should be carefully examined in advance.

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(HOT) WATER SUPPLY

In Western Europe, the per capita consumption of water has increased in recent decades;[19] recent hot and dry summers have sometimes contributed to a difficult supply situation in parts of Germany. With regard to energy consumption, the use of hot water, in particular, should be reduced as much as possible if it is not mandatory. There are also numerous technical solutions that help to reduce water flow at the fittings. Installation of an automatic water shut-off is recommended, particularly at tapping points accessible to the public. For any saving measures, it is obvious that compliance with hygiene requirements for water consumption in the medical field must be strictly observed. In this context, the Robert Koch Institute (RKI) and respective publications from the field of hospital hygiene provide guidance.[20] The design of green areas should also be included in plans for reducing fresh water consumption.

For any saving measures, it is obvious that compliance with hygiene requirements for water consumption in the medical field must be strictly observed.

HEATING/COOLING

Measures to improve insulation (facades, windows, roofs) may be available; for new buildings, modern heating and cooling systems should be preferred during acquisition. With respect to the heating and cooling of rooms, correct ventilation should be practiced consistently by the team. A permanently tilted position of windows in cold weather should be avoided in favor of opening the windows wide for a short time; in the hot season, they should only be opened early in the morning. In areas open to the public, such as waiting rooms, windows should only be opened and closed by personnel if necessary. Moreover, many recommendations from the private area are also appropriate in the context of a clinic or office; radiators should be maintained regularly and kept free to ensure sufficient air circulation. The room temperature should be adequate and not too high during heating (max. 20°C), and the heater should be downregulated at night. Special treatment areas, for example in pediatric dermatology, can be excluded if there are special requirements. In areas requiring ventilation or cooling (surgical areas, laboratories), one can assess whether continuous operation is required or whether savings are possible by programming or deactivation at night.

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TRAFFIC AND MOBILITY

Apart from the reduction of CO_2 emissions, the reduction of motorized private transport offers numerous co-benefits.

The use of public transport contributes to improvement of air quality, and increased active transport by using a bicycle or walking for transport promotes individual health.

The use of public transport contributes to improvement of air quality, and increased active transport by using a bicycle as a mode of transport or walking promotes individual health (compilation of the German Environment Agency on bicycle traffic, internet link:[21]). The use of these modes of transport can therefore be promoted in the field of medicine for both patients and personnel by creating a healthy environment. For existing facilities, only limited influence can be exerted on office location and the respective connection to public transport; starting points for increasing bicycle use could be installation of (safe) bicycle stands, promotional programs, and charging opportunities for electric bicycles (e-bikes). Respective activities are summarized in the bicycle portal of the German Federal Ministry of Transport and Digital Infrastructure (internet link:[22]). For locations that can only be reached by car, the purchase of electric cars may be appropriate. Carpools are also an effective method to reduce emissions.

OFFICE ORGANIZATION, DIGITALIZATION, AND PERSONNEL

Optimization of workflows and administration will save resources (and usually time and money as well). Depending on the size of the facility, various measures may be considered. An important aspect is the avoidance of paper, which may be achieved by digitalization of work processes (including appointments, transmission of findings or electronic patient records), and more immediately by double-sided printing. Promotional material should be cancelled if possible. In the area of purchasing and office supplies, switching to a provider with a focus on sustainability may be considered. With regard to hygienic requirements, workflows need to be assessed to determine whether additional consumables such as absorbent underlays or examination gloves are necessary. An example is the leaflet "Sustainable vaccination" by the German Society of Tropical Medicine, Travel Medicine and Global Health (internet link:[23]); from a hygienic point of view, the use of gloves and patches is not required when performing a vaccination.

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Office finances also play a role; reserves can be withdrawn from energy-intensive fields in favor of sustainable business areas (divestment). Banks with sustainable corporate strategies may be preferred over competitors.

In large facilities (especially in the inpatient sector), sustainable catering can be emphasized. A focus on seasonal, regional, and sustainably grown products will save emissions by shortening transport routes and emphasizing ecologically sound methods of cultivation. Furthermore, incentives can be created to make food with a low CO_2 equivalent particularly attractive. For example, sustainable meals may be established as a "standard menu" with a central place at the serving area of the canteen.

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Overall, hygienic measures that were taken to combat the Covid-19 pandemic resulted in a boost in the field of digital applications and in teledermatology. This reduced travel by patients and home visits by physicians. Such reductions in travel could be beneficial for the climate. However, for a realistic calculation, influencing factors such as electricity consumption by terminal devices and data traffic (as well as necessary purchases) need to be considered. So far, initial evaluations are only available for economic efficiency and medical validity, but not for sustainability.[24] However, in 2021 a report from the United Kingdom presented calculations that suggested a substantial potential for CO_2 savings, especially in hospitals with a large catchment area.[25] Furthermore, optimization of digital processes provides numerous opportunities for increased satisfaction of personnel and patients. Based on the experience of one author contributing to this article, involvement of employees in implementing sustainable measures results in positive responses and increased work satisfaction (internet link:[26]).

HYGIENE AND CLEANSING

Hand and surface hygiene are essential protection measures against infection. Currently, however, evaluation of sustainability aspects of disinfectants and cleansing agents is only possible with respect to criteria for use and disposal. Further information on the origin of raw materials, production sites and supply chains is often not available.

HAND HYGIENE

Since the medical and legal requirements are narrowly defined, under no circumstances should use of hand sanitizers be limited in favor of sustainability.

The most suitable method for hygienic hand disinfection is the use of alcohol-based hand disinfectants.

The most suitable method for hygienic hand disinfection is the use of alcohol-based hand disinfectants (ethanol, propanol). The limited effectiveness of alcoholic preparations in case of certain pathogens (for example, Clostridia) must be considered.[27] The German Commission for Hospital Hygiene and Infection Prevention (*Kommission für Krankenhaushygiene und Infektionsprävention*, KRINKO) advises against preparations with addition of antimicrobial agents with lasting effects (chlorhexidine, triclosan, mecetronium ethylsulfate), given that there is no improved

TABLE 2 Comparison of surface cleansing methods in absence of robust evidence

	Basic effectiveness VAH	Effectiveness against viruses (Source: product folder)	Hazardous substance	Solution biodegradable
Incidin™ Plus (Ecolab)	0.5%/1 h	EN 14476, noro, n.d. EN 14476, adeno 2%/120 min	Yes	No
Terralin® protect (Schülke & Mayr)	0.5%/1 h	EN 14476, noro 1%/120 min EN 14476, adeno 2%/240 min	Yes	No
Microbac® forte (Bode / Hartmann)	0.5%/1 h	EN 14476, noro 1%/240 min EN 14476, adeno 1.5%/240 min	Yes	No
DesiMops™ (CleaningBox)	*Ready to use*	EN 14476, EN 16615 noro, 1 min EN 14476, adeno 5 min	No	Yes

Abbr.: VAH, Association of Applied Hygiene; noro: norovirus; adeno: adenovirus

effectiveness compared to alcoholic solutions but an agent-related increased risk of intolerance and resistance.[27] Very few recommendations for agents with increased environmental compatibility are available for hand disinfection. However, the use of small containers for the coat pocket appears to be problematic: single use with no opportunity to refill containers will generate more waste, and there is also an increased risk of contamination in case of wrong handling.[27] At the present moment, the optimal solution is completely recyclable containers with vacuum technology that relieves transport chains due to their low weight.

SURFACE DISINFECTION AND OFFICE CLEANING

Surfaces in areas of patient care or with activities including biological materials must be smooth, wipeable, disinfectable and have sealed joints. Notwithstanding the above, there are specific hygienic requirements for the disinfectants and cleansing agents used, and the KRINKO also stipulates an ideal environmental compatibility.[28] Commonly used agents for surface disinfection are quaternary ammonium compounds (QACs), which are subject to the Biocidal Products Regulation and are listed as hazardous substances. An important limiting factor for the choice of QACs in disinfectants is its acceptance by controlling bodies such as the EPA (*United States Environmental Protection Agency*), and the EU directive concerning the placing of biocidal products on the market.[29] In offices, disinfection of surfaces and floors is usually performed with a two-bucket wiping method; this is very time-consuming, requires a separate sink and results in downtimes for the rooms to in order to clean. Disinfection in one process would therefore be beneficial from an economic point of view. A potential alternative might be disposable wiping systems based on peracetic acid (PAA), since these systems are biodegradable by more than 99% (Table 2) (internet link for list of disinfectants of the German Association of Applied Hygiene:[30]). At the moment, however, almost no evidence-based recommendations on the improvement of sustainability are available that meet the high hygienic requirements in the area of medicine. There is a therefore a significant need for research.

PRESCRIPTION PRACTICES AND DRUGS

In a background paper, the German Environment Agency classifies approximately half of the drugs available in Germany as potentially relevant for the environment.[31] Reasons for this assessment may be potential ecotoxicity or long persistence in the environment. Moreover, it has to be considered that the production and packaging of drugs is accompanied by consumption of resources at the production sites. Potential approaches for reducing the amount of packaging material and establishing recycling are already addressed.[32] However, given the legal framework and the needs of patients and physicians (storage, counterfeit protection, costs), these solutions are complex.[33] In addition, supply chains have been extended in recent decades in the context of globalization, and a large proportion of drugs for the European and American market is now produced in Asia. The prime rationale of pharmacological therapy should be a good indication; avoidance of overtreatment supports sustainability. In addition, appropriate amounts should be prescribed and polypharmacy should be critically questioned on a regular basis. Integration of digital prescription aids may be useful for this purpose. The Swedish healthcare system has compiled a "smart list" for drug prescription. This considers data on effectiveness, safety, pharmaceutical appropriateness, cost efficiency, and environmental aspects. While the list is not directly applicable to Germany, it provides a certain orientation (www.klokalistan.se). With regard to aspects of sustainability, the prescription of antibiotics and painkillers is particularly relevant and should consider both the current guidelines (www.awmf.org) and the German Antibiotics Resistance Strategy (*Deutsche Antibiotika-Resistenzstrategie*, DART).[34] The relevance of pharmacists with respect to sustainable prescription cannot be overestimated, so intensified cooperation is desirable. Potential pharmaceutical fields of action in the area of planetary health have recently been summarized in a commenting article.[35] Aspects of sustainability should be implemented

increasingly in medical recommendations for action and guidelines as soon as possible.

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With respect to their CO_2 equivalent, some preparations used in dermatology and allergology should be mentioned.

Due to the included propellants, metered-dose inhalers have a much higher greenhouse potential than dry powder inhalers.

Due to the included propellants, such as norflurane (HFC-134a), metered-dose inhalers have a much higher greenhouse potential than dry powder inhalers. A helpful S1 recommendation for action regarding the prescription of inhaled drugs was published in 2022.[36] Furthermore, various anesthetic gases have very different CO_2 equivalents.[37] Worldwide, volatile anesthetics caused a CO_2 equivalent of 3 million tons in 2014. Desflurane alone accounted for 80%. Depending on the surgical procedure, the possibility of total intravenous anesthesia (TIVA) should therefore be assessed, since this is associated with a lower greenhouse potential, as shown in a life-cycle analysis of volatile anesthetics taking production, packaging, transport, application, and waste management into account.[38] Regional anesthetic techniques may also contribute to reducing the use of anesthetic gases. Additional approaches include low-flow concepts and the establishment of gas recycling systems.[39]

According to a study from 2021 of the calculated emission of greenhouse gases by the *National Health Service* (NHS) in Great Britain,[15] anesthetic gases and metered-dose inhalers account for 767 kilotons (kt) of CO_2 equivalents in primary care. In addition, an amount of 2,750 kt is used for other drugs and the total amount is 5,770 kt. This highlights the great importance of prescription practice with respect to sustainability.

DERMATOLOGICAL EXTERNAL PRODUCTS

The prescription of agents in tinctures, lotions, creams, and ointments is an inherent feature of dermatology. For many dermatoses, basic treatment with lipid replenishing and rehydrating preparations is also indispensable. In addition, specific treatment goals of topical formulations such as sun protection or the positive effect on aging processes (*anti-aging*) should be mentioned. A very large portion of these products is dispensed in plastic packaging, sometimes made of composite materials with more complicated recycling. This is relevant because plastic compounds are considered "novel entities" and may accumulate in the environment all over the world due to improper disposal. At the same time, there is also a direct association between plastic production and climate change due to primarily petrol-based synthesis and the formation of greenhouse gases during degradation of certain plastics (for example, polyethylene) in the environment.[40,41] A significant reduction of plastic consumption must be considered as a common task within the dermatological community. Against this background, we would point out the existence of very small packaging units that generate disproportionate amounts of waste. Furthermore, many cosmetics contain microplastic and synthetic polymers, although their definition is not consistent. Potential effects of these compounds on the environment are described in detail in a study by the Fraunhofer Society.[42] The use of alternatives with better biodegradability (including cellulose, gelatin and starch) may be equally suitable. The difference between the environmentally harmful potential of certain sun protection products should also be mentioned.[43] It is the responsibility of the dermatologist to inform patients about potentially harmful ingredients in external products and to play a critical role in their selection. With respect to environmental compatibility and sustainability of dermatological external products, uncertainty may occur on the part of both the practitioner and the patient, and this should be addressed by high-quality research in this area.

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WASTE MANAGEMENT

In Germany, proper waste separation in private households is a matter of course and a prerequisite for successful recycling. This should also be strictly observed in offices and clinics. There may be different modalities depending on the municipality; in a British study, dermatological peculiarities are specifically addressed based on a diagram.[44] The different handling of drug disposal between regions poses a problem. Depending on the municipality, adequate disposal opportunities are domestic waste, collection vehicles for hazardous waste, recycling centers or pharmacies (on a voluntary basis). However, disposal by sanitary facilities is precluded.

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Laboratories are responsible for a large amount of waste. For some years, the requirement for sustainable

TABLE 3 Advantages and disadvantages of the use of single-use instruments and processing of surgical instruments

	Advantages	Disadvantages
Single-use instrument	– Compliance with all regulations – No controls by GA and RP – Saving of time- and cost-intensive workflows – Elimination of costs for repair, energy, water, and cleansing agents	– High energy expenditure in production – Low recycling rate – High consumption of resources – High waste generation – Large proportion of packaging material
External processing	– No acquisition costs – Compliance with all regulations – Less elaborate controls by GA and RP – Saving of time- and cost-intensive workflows – Elimination of costs for repair, energy, water, and cleansing agents	– CO_2 emissions by supply chains – Large quantity of equipment required – Dependence on external providers
Processing in own office	– No supply chains – Individually required packaging – No dependence on external providers – Flexible supply management	– High acquisition costs for instruments – Regular maintenance and validation required – Costs for repair, energy, personnel

Abbr.: GA, Health department; RP, regional council

transformation has also been increasingly addressed in this area.[45] Already approximately 30 years ago, pioneering work referred to opportunities for sparing resources with a primary focus on saving paper.[46] The economic use of chemicals and modalities for recycling is considered increasingly in pathology.[47] Liquid chemicals can often be purified and separated by vaporization and subsequent reliquefication (distillation); solidification to larger flocs with subsequent removal by filtering or sedimentation is suitable for particles (flocculation). Plastic is also ubiquitous in routine and research laboratories. In 2021, a microbiology research group consisting of seven individuals estimated that their monthly amount of plastic waste was 97 kg and reduced this amount by more than 40% [48] by implementing numerous activities. Specific fields of action have been published by the University of Westminster. For example, it was pointed out that experimental approaches should be planned with adequate containers and that autoclaving and reutilization of certain containers is possible (internet link:[49]). Reviews pooling sustainable measures in tabular form are also available for the operation of routine laboratories.[50]

It is important to note that the most effective procedure is to avoid generation of waste in the first place. Especially in clinics, multiple-use solutions (coffee mugs) or 'upcycling' can be introduced for this purpose. In 'upcycling', waste and seemingly useless items are given a new purpose, such as decoration.

DERMATOSURGERY

Surgical fields such as dermatosurgery are material- and resource-intensive. Aspects of hygiene and sterile processing are a significant economic factor in surgical facilities. The decision as to whether surgical instruments are used as disposable instruments with internal or external processing depends on various factors. Apart from the space availability for internal processing, the number of daily operations is particularly important. A comparative analysis is shown in Table 3. Due to numerous factors, the recycling of single-use instruments is currently energy-intensive and uneconomic. It is therefore not yet established in Germany. Practical experience with the transformation to the "green operating room" was published in 2013.[51] An interdisciplinary team at a large American hospital with more than 17,000 annual inpatient operations established sustainability measures and achieved a reduction of more than 1,000 kg of medical waste per year. Reduced electricity consumption and other measures for the conservation of resources resulted in a potential saving of more than 100,000 US dollars per year. Research studies on this subject were recently summarized in an Australian review.[52] Most of these studies were performed in the USA, Great Britain and Australia, while only one German study was identified. As in other sections of a hospital, approaches mentioned consisted of strict waste separation (including separation of various plastics such as polypropylene and polyethylene among others) as well as suitable disposal, recycling and the conscientious use of drugs and resources. Main barriers for the implementation of sustainable measures can be attributed to the personnel, usually in terms of their uncertainty with regard to hygiene requirements, worries about higher workload and lack of guidance. These aspects can be addressed by training courses and a respective business culture. However, a recent review concludes that there is a lack of top-quality studies and that the evidence of sustainability measures in the surgical area is still low.[53] in 2020, specific dermatosurgical aspects were identified in a perspective article with the keywords *"reduce – reuse – recycle – rethink – research"*.[54] One approach is the use of suitable sieves and strict documentation of unused instruments to relieve processing.

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For smaller interventions on the skin, surgical gowns and headgear are not mandatory.

A specific proposal to improve the sustainability of Mohs surgery was also published recently.[55] This included the use of a hyfrecator (a device with the capacity of electric desiccation) instead of a complete electrosurgical unit requiring a neutral electrode. The *British Society of Dermatologists* has a sustainability committee which is engaged with the generation of more evidence in dermatosurgery and dermatology in general.[56]

EVALUATION AND QUALITY MANAGEMENT

Conversion to sustainable medical activity is an ongoing process that requires regular reviews and adjustments. These can be integrated systematically into existing quality management (QM) systems. The Sustainability work group (*Nachhaltigkeit in der Dermatologie e.V.*, AGN) in the German Society of Dermatology (*Deutsche Dermatologische Gesellschaft*, DDG) is continuously developing QM templates that are made accessible free of charge. These are available at the homepage, www.agderma.de. In addition, numerous checklists for the implementation of sustainability measures have been established during the *KLIK Green* project (including: food supply). Apart from the AGN of the DDG, several sustainable initiatives in Germany are listed in Figure 1. Interdisciplinary networking for the pooling of expertise is currently proceeding. A recent article with a focus on ophthalmology is also of interest.[57]

Conversion to sustainable medical activity is an ongoing process that requires regular reviews and adjustments.

SUMMARY AND OUTLOOK

In summary, the current situation where planetary boundaries are regularly exceeded and there is high resource consumption in the healthcare system demands urgent efforts to achieve more sustainability in medicine and dermatology. General areas include the energy sector, traffic and mobility, prescription practice and waste management. Put simply, sustainable medical facilities minimize waste and the use of resources, which may offer a competitive advantage. Specific features of dermatology are the use of external products and cosmetics as well as the resulting requirement for sustainable ingredients and packages. Opportunities and perspectives are also provided by the adjustment of outdated workflows. Specifically, sustainable transformation provides the opportunity for more satisfaction in the daily routine as well as greater interprofessional cohesion. As a secondary effect, sustainable medicine could also have a positive effect on the behavior of the patient, because the medical professions enjoy an excellent reputation in the population. Given that the subject of sustainable clinic and office management as a whole is very complex, the continuous commitment of all parties in the healthcare sector is required. Evaluation and QM measures may help to identify respective potentials and quantification of progress.

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D.N.: Abbvie, Almirall, BMS, Eli Lilly, GlaxoSmithKline, Kyowa Kirin L'Oréal, MSD, Novartis, Pfizer, UCB Pharma.

S.S.: Biofrontera, Lilly.

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[[CME Questions / Lernerfolgskontrolle]]

1. Welcher der folgenden Aspekte wird nicht zu den planetaren Belastungsgrenzen gezählt?
   a. Süßwasserverbrauch
   b. Korallenbleiche
   c. Verlust der Biodiversität
   d. Umweltbelastung durch Chemikalien
   e. Landnutzung

2. Das Drei-Säulen-Modell (triple bottom line) beschreibt eine Entwicklung, die folgende Bedürfnisse gleichermaßen berücksichtigt:
   a. Globale, interkontinentale und nationale Aspekte
   b. Primär-, Sekundär- und Tertiärprävention
   c. Reduktion der Säuglingssterblichkeit, Müttersterblichkeit und übertragbarer Erkrankungen
   d. Ausbau erneuerbarer Energien, Reduktion der Nutzung fossiler Energieträger und Einsparungen durch technische Effizienzsteigerung
   e. Ökologische, ökonomische und soziale Aspekte

3. Gemäß aktuellen Forschungsergebnissen nimmt welcher Teilbereich der stationären medizinischen Versorgung den größten Anteil an Kohlendioxid-Emissionen ein?
   a. Einkauf medizinischer Güter und medizinische Leistungen
   b. Medikamente
   c. Anästhesiegase
   d. Direkter Energieverbrauch der Medizingeräte
   e. Verkehr und Mobilität

4. Unter Co-Benefits im Rahmen der Reduktion von Kohlendioxid-Emissionen wird Folgendes verstanden:
   a. Kurzfristige finanzielle Vorteile durch Installation von Photovoltaikanlagen
   b. Ein Synonym für Entwicklungszusammenarbeit mit dem Ziel der Implementierung nachhaltiger Maßnahmen in Entwicklungsländern (Deutsch: Ko-Benefiz)
   c. Individueller Zusatznutzen oder positive Nebeneffekte
   d. Mittelfristige Renditesteigerung börsennotierter Unternehmen durch Verbesserung des CO_2-Fußabdrucks
   e. Finanzielle Förderung nachhaltiger Unternehmen im Rahmen der Horizont Europa Missionen

5. Welche Aussage zur Verbesserung der Nachhaltigkeit von Hygienemaßnahmen trifft zu?
   a. Eine Kontamination von Desinfektionsmittelspendern für die Kitteltasche ist ausgeschlossen.
   b. Präparate auf Basis quartärer Ammoniumverbindungen eignen sich besonders zur Händedesinfektion.
   c. Die KRINKO als Organ des RKI rät dazu, den Gebrauch von Antiseptika indikationsgerecht zu evaluieren und bestimmte Präparate für die Händedesinfektion zu meiden.
   d. Zur Einsparung von Gebrauchsmaterialien sollte die Händedesinfektion auf Patientenkontakte mit gesicherten multiresistenten Erregern reduziert werden.
   e. Zur Umweltverträglichkeit von Flächendesinfektionsmitteln liegt eindeutige Evidenz in Bezug auf die nachhaltigsten Substanzen vor.

6. Welche Aussage zur Nachhaltigkeit des Arzneimittelgebrauchs ist zutreffend?
   a. Narkosegase zerfallen in der Atmosphäre rasch in Wasserstoff und Sauerstoff und haben daher keine relevante Auswirkung auf den Treibhauseffekt.
   b. Arzneimittel können einfach und sicher vollständig aus Abwässern entfernt werden, daher ist eine Entsorgung über die Toilette möglich.
   c. Weit über 90% der verwendeten Arzneimittel sind in Bezug auf die Umwelt als unproblematisch anzusehen.
   d. Extern angewandte Wirkstoffe werden anteilig abgewaschen und können zur Belastung von Abwässern beitragen.
   e. Arzneimittelverordnungen machen einen verschwindend kleinen Anteil am CO_2-Fußabdruck einer gewöhnlichen Arztpraxis aus.

7. Welche Haltung wurde beim 125. Deutschen Ärztetag im Abschlussprotokoll sinngemäß festgehalten?
   a. Treibhausgasemissionen werden hauptsächlich über den Industriesektor (zum Beispiel Metall-Verhüttung) verursacht, eine Reduktion des CO_2-Fußabdrucks des Gesundheitssystems ist vor dem Hintergrund der Covid-19-Pandemie mittelfristig nicht möglich.
   b. Veränderte klimatische Bedingungen sind in Deutschland in Bezug auf die Patientenversorgung zu vernachlässigen.

c. Maßnahmen zur Abfallreduktion und Steigerung des Recyclinganteils sind angesichts der hohen rechtlichen Rahmenbedingungen von medizinischen Abfällen von vornherein zum Scheitern verurteilt.
d. Die Bundesärztekammer ist aus Maßnahmen zu mehr Nachhaltigkeit ausgegliedert.
e. Das deutsche Gesundheitssystem und ärztliche Organisationen sollten Klimaschutz in das alltägliche Handeln integrieren und bis zum Jahr 2030 Klimaneutralität anstreben.

8. Welche der folgenden nachhaltigen Maßnahmen kann völlig kostenneutral in den Praxisalltag integriert werden?
   a. Fassadenbegrünung und bauliche Maßnahmen
   b. Kühlschranktemperatur auf das notwendige Maß regulieren
   c. Modernisierung der Heizsysteme
   d. Verbesserung der Anbindung an den ÖPNV
   e. Dienstwagenflotte um Elektroautos erweitern
9. Die Digitalisierung könnte über welche der folgenden Mechanismen dazu beitragen, Kohlendioxid-Emissionen des Gesundheitssystems zu reduzieren?
   a. Verwendung von Digitalwährungen (z. B. Bitcoin) als Zahlungsmittel für individuelle Gesundheitsleistungen
   b. Hoher Datenverkehr durch extensive Nutzung von Videosprechstunden
   c. Verbesserte Arbeitsorganisation mit Reduktion des Papierverbrauchs und der notwendigen Archivfläche
   d. Zusätzliche Kommunikation mit den Patienten via Chatbots.
   e. Nutzung sozialer Medien für Werbezwecke
10. Welche Aussagen zu nachhaltigen Initiativen im Gesundheitswesen ist richtig?
   a. Die Ärzteschaft steht in ihrem Bestreben zu mehr Nachhaltigkeit isoliert da.
   b. In verschiedenen Fachgesellschaften (zum Beispiel Deutsche Gesellschaft für Innere Medizin) wurden nachhaltige Initiativen etabliert, die sich untereinander vernetzen.
   c. Das KLIK-Green-Projekt wurde kürzlich um eine Laufzeit von weiteren fünf Jahren verlängert.
   d. Innerhalb der Deutschen Dermatologischen Gesellschaft gibt es bisher keine Initiative für mehr Nachhaltigkeit.
   e. Die meisten nachhaltigen Initiativen im Gesundheitssystem sind an politische Parteien angegliedert.

Liebe Leserinnen und Leser,
der Einsendeschluss an die DDA für diese Ausgabe ist der 31. März 2023. Die richtige Lösung zum Thema „Infektionen mit Herpes-simplex- und Varizella-zoster-Virus“ in Heft 10 (Oktober 2022) ist: 1b, 2e, 3d, 4c, 5b, 6e, 7b, 8c, 9a, 10b

Bitte verwenden Sie für Ihre Einsendung das aktuelle Formblatt auf der folgenden Seite oder aber geben Sie Ihre Lösung online unter http://jddg.akademie-dda. de ein.