

Role of dentistry in the health sciences, the dental team.

Environmental aspects in dentistry.

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# PART I.



Role of dentistry in the health sciences,  
the dental team

# Dentistry – Past and present

- A **Sumerian** text from 5000 BC describes a "tooth worm" as the cause of dental caries.
- Evidence of this belief has also been found in **ancient India, Egypt, Japan, and China**



# Dentistry – Past and present

- 2600 B.C. : The first known dentist was an **Egyptian** named **Hesi-Re**
- 700-510 B.C. **Etruscan period** of dentistry.
- Some examples of their **fixed or removable bridgework** have been preserved in various museums



# Dentistry – Past and present

- 500-300 B.C.: **Hippocrates and Aristoteles** wrote about dentistry, including:
  - the **eruption pattern** of teeth
  - treating **decayed teeth** and **gum disease**
  - **extracting** teeth with forceps
  - using wires to **stabilize loose teeth** and fractured jaws.



# Dentistry – Past and present

- 25 B.C. - 50 A.D. – **Celsus** believed that General Physical deterioration caused dental diseases. For tooth aches he prescribed:
  - **Mustard seed.**
  - **Alum** for soft tissue disease.
  - **Extraction** of badly broken down teeth. He recommended filling the cavity with **lead** prior to extraction to avoid fracturing the crown.
- Gave first technique for **tooth positioning**



# Dentistry – Past and present



- **The Barber-Surgeons**

- Onset of the Middle Ages: **monks** became physicians and dentists; barbers acted as assistants to the monks.
- 1163: the pope ruled that any bloody operation was incompatible with the priestly office → the **barbers** took over the practice of Surgery.
- They plied their trade in **public squares**.
- France from 1700: anyone desiring to practice oral surgery and restorative dentistry had to take a **regular prescribed exam**



# Modern dentistry

- **Pierre Fauchard** → French surgeon, "father of modern dentistry".
- Despite the primitive surgical instruments during the late 17th and early 18th century, Fauchard was a surgeon who made remarkable improvisations of **dental instruments**, often adapting tools from watch makers, jewelers that he thought could be used in dentistry.
- Publishes **The Surgeon Dentist (Le Chirurgien Dentiste)**: basic oral anatomy and function, operative and restorative techniques, denture construction

# Modern fogászat

- 1840: The **first dental college in the world**, the Baltimore College of Dental Surgery
- 1872 A.D.: **First foot-driven dental engine**, invented by **Morrison**



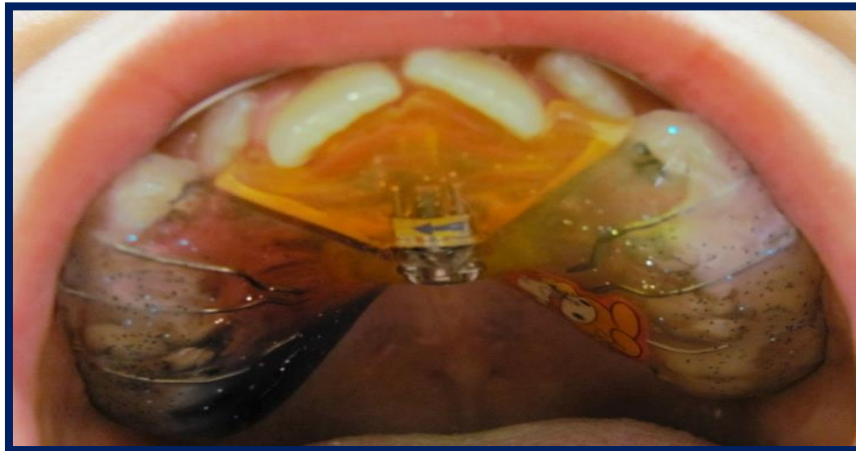
# Specialities of dentistry

- Dentistry today is somewhat specialized.
- The chronological order of the establishment of the **eight specialities**:
  - 1. 1901 Orthodontics
  - 2. 1918 Oral Surgery
  - 3. 1918 Periodontics
  - 4. 1918 Prosthodontics
  - 5. 1927 Pedodontics
  - 6. 1937 Public Health
  - 7. 1946 Oral Pathology
  - 8. 1963 Endodontics



# Orthodontics

- Diagnosis and **treatment of malocclusions** (improper bites), which may be a result of tooth irregularity, disproportionate jaw relationships, or both.
- Orthodontic treatment can focus on **dental displacement** only, or can deal with the control and modification of **facial growth**.



# Oral Surgery

**Dento-alveolar surgery**

**Maxillo-facial surgery**

- Diagnosis, surgical and related treatment of **diseases, injuries and defects** involving both the functional and esthetic aspects of the hard and soft tissues of the head, mouth, teeth, gums, jaws and neck.



# Periodontics

- Studies **supporting structures of teeth, diseases, and conditions that affect them.**
- The supporting tissues are known as the periodontium, which includes the gingiva (gums), alveolar bone, cementum, and the periodontal ligament.



# Prosthodontics

- Dental specialty pertaining to the diagnosis, treatment planning, rehabilitation and maintenance of the oral function, comfort, appearance and health of patients with clinical conditions associated with **missing or deficient teeth and/or oral and maxillofacial tissues** using biocompatible substitutes



# Pediatric dentistry

- This discipline focuses on pediatric/adolescent **growth and development**, disease causality and **prevention, child psychology and management**, and all aspects of the highly-specialized pediatric **restorative techniques and modalities**.
- Treatment of **deciduous and permanent teeth** under the age of **18**



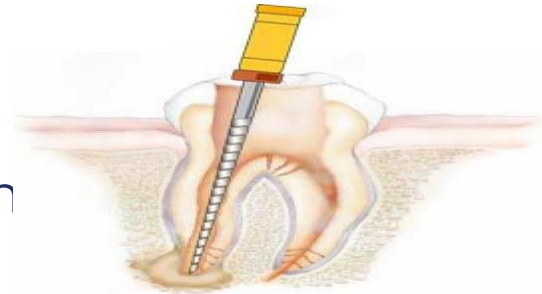
# Oral Pathology

- The clinical evaluation and diagnosis of **oral mucosal diseases** are in the scope of oral & maxillofacial pathology specialists and oral medicine practitioners
- When a **microscopic evaluation** is needed, a biopsy is taken from the lesion, and microscopically observed by a pathologist.



# Endodontics

- Endodontists perform a variety of procedures including endodontic therapy (commonly known as "**root canal therapy**") and related interventions, including:
  - endodontic retreatment
  - endodontic (micro)surgery
  - treating cracked and fractured teeth
  - treating dental trauma.
- Root canal therapy is one of the most common dental procedures.



# The dental team

- Members:
  - Dentists (with or without further specialisations)
  - Dental assistants
  - Dental hygienists
  - Dental technicians
  - Dental office managers
  - Patient coordinators
  - Receptionists



## PART II.

### Environmental aspects in dentistry.

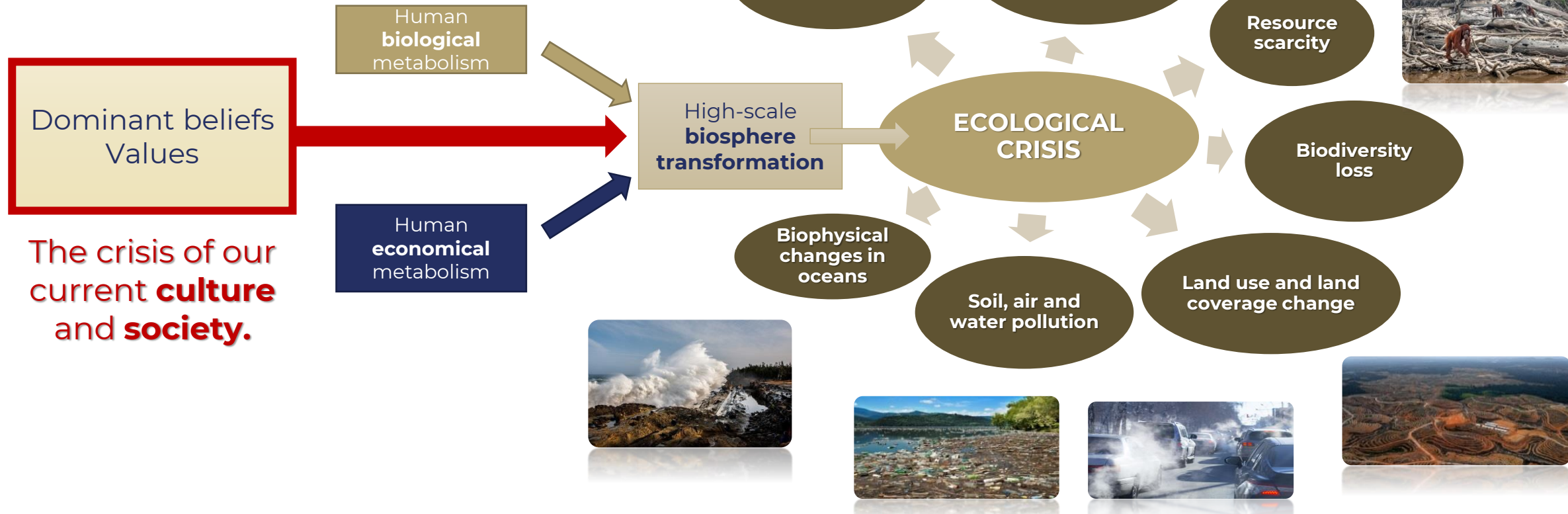


*Ecological footprint of dental treatments.*

*Sustainability in dentistry and dental waste management.*

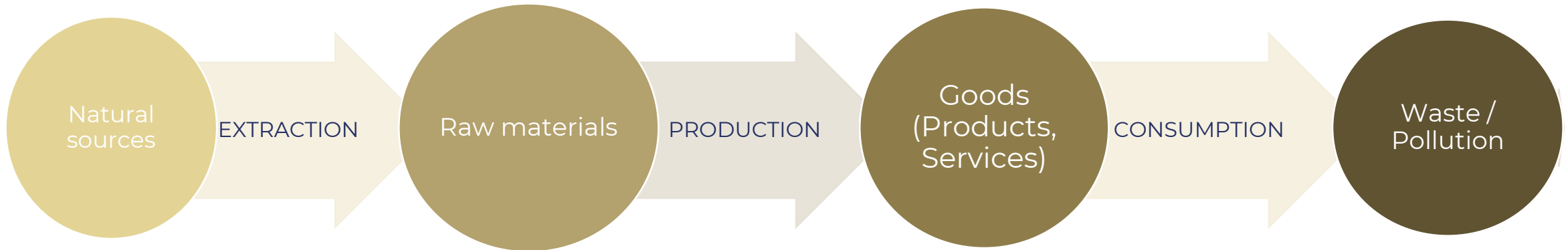
# Ecological crisis

Humanity has become capable of **transforming the biosphere on a massive and rapid scale**, threatening its own life conditions.



# Why is this topic important?

- **We are living in an ecological crisis!**
- Reason: Major and quick **transformation of the biosphere** by humanity through their economical processes embedded into the society → **threatening our own life conditions**



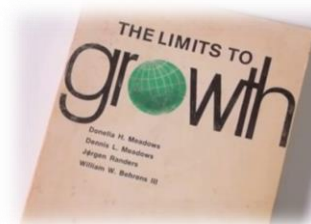
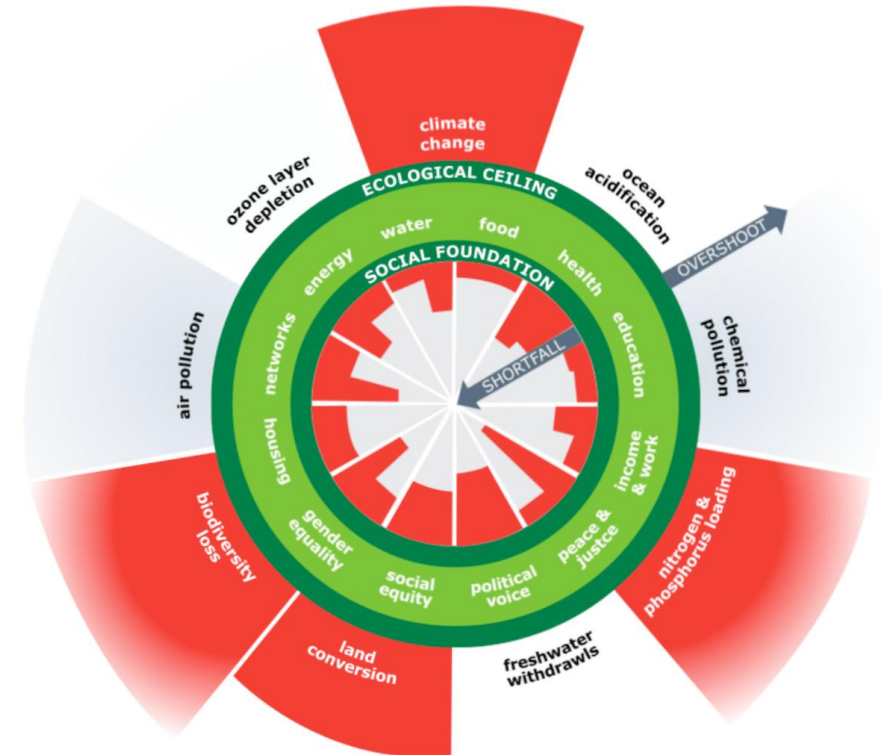
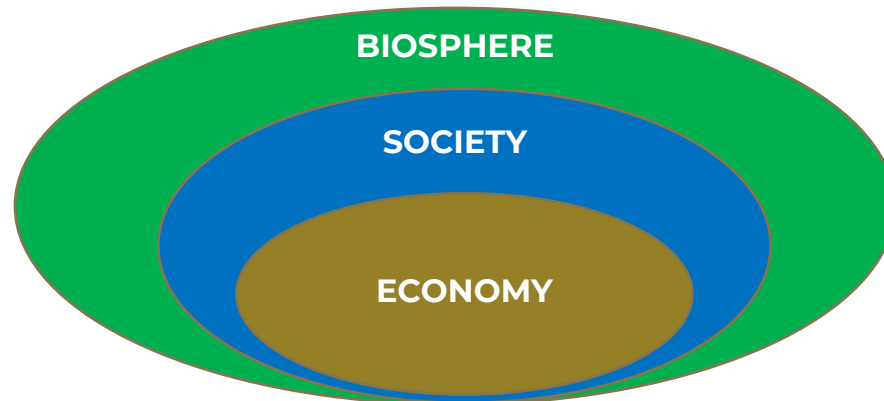
- 21. Century → consequences of human transformation of the biosphere: **accelerated climate change and environmental pollution → irreversible damage** to our ecosystems worldwide → **threatening human health and well-being**

# Sustainability – sustainable development?

## Sustainable development

Developmental process which fulfills the needs of the current generation, without sacrificing the ability of the future generations to fulfill their own needs.

(UN1987 Brundtland Report)



→ Well-being instead of Welfare

→ „Doughnut Economy”

→ Degrowth

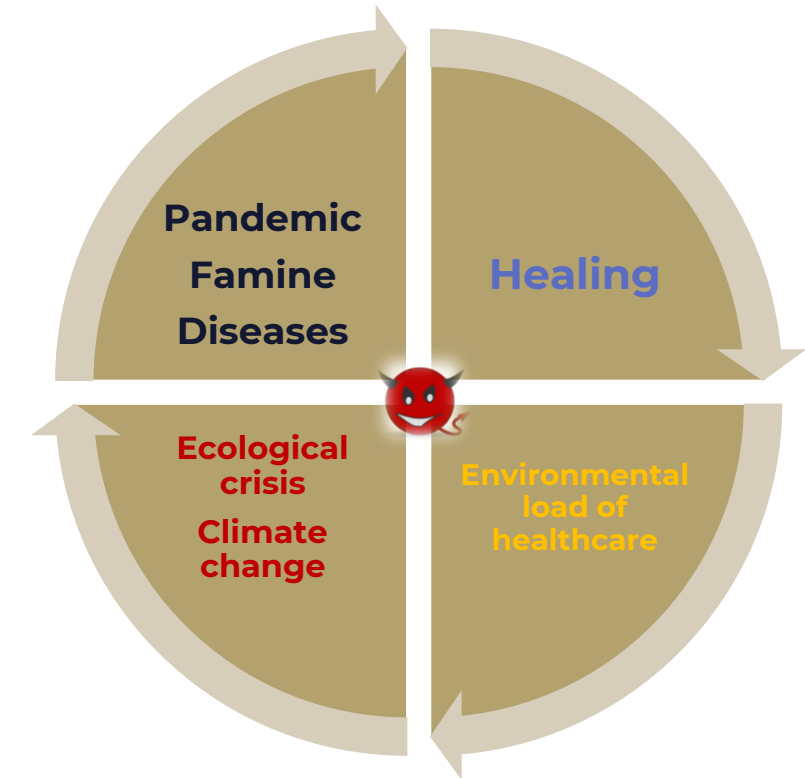
A fenntartható fejlődés fogalma, 2018. <https://eionet.kormany.hu/a-fenntarthato-fejlodes-fogalma>  
<https://www.clubofrome.org/history/>  
<https://eionet.kormany.hu/novekedes-gazdasagi-novekedes-nelkul>  
<https://doughnuteconomics.org/about-doughnut-economics>

# Sustainability in healthcare

- The **health sector** itself, including **dentistry**, is both the cause and the victim of the ecological crisis.

„When **health institutions** treat sick people, they are also using the **Earth's resources**. Thus, healing work inevitably contributes to the **strain on the environment** and ultimately to the **degradation of the Earth's ecological state**.” (Antal Z. László)

- **There is no health on a sick planet!**
- **Hippocrates' Oath** - Extending our **moral duty to the environment**: „*Primum non Nocere*” - „Do not harm!”

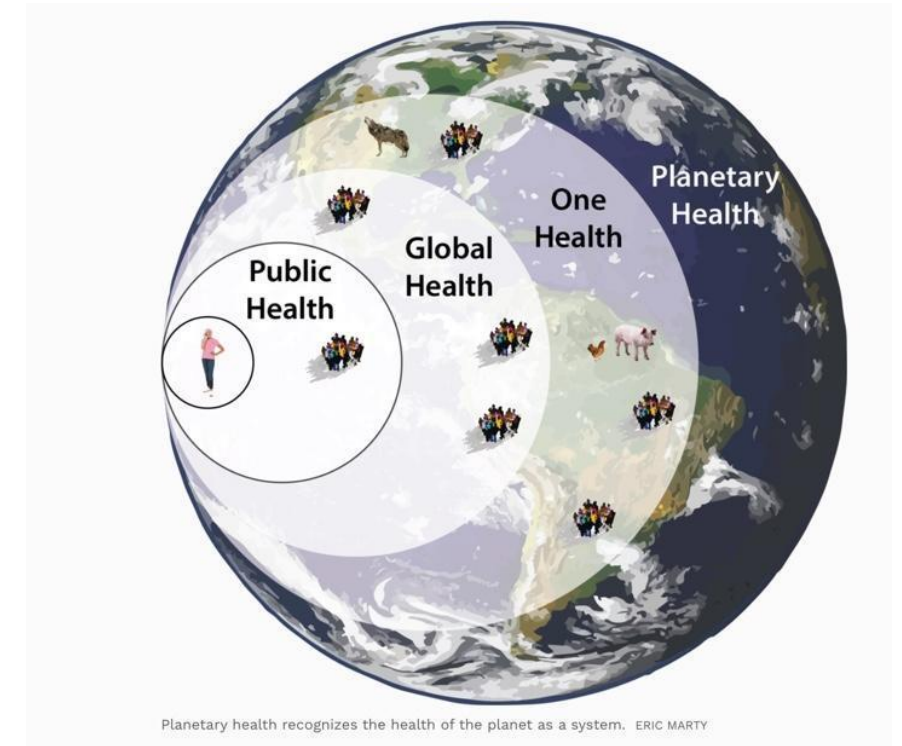


Antal ZL. Az éghajlatváltozás hatása a társadalom életére és az egészségügyi ellátásra. Mentálhigiéné és Pszichoszomatika 19 (2018) 3, 268–290

# Sustainability in healthcare

## Dimensions of health

- Individual health
- Public health
- Global health
- One health
- Planetary health

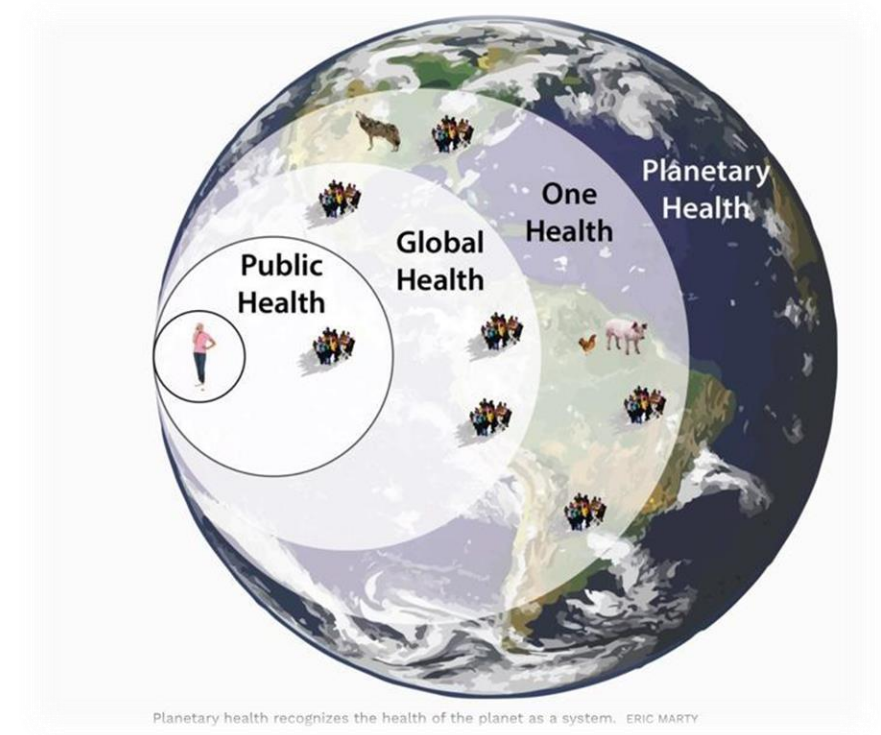


<https://www.forbes.com/sites/johndrake/2021/04/22/what-is-planetary-health/?sh=21b235912998>

# Sustainability in healthcare

## Planetary Health

- **Restoring biodiversity** and **preserving natural capital** are the basis for the functioning of ecosystems that enable healthy human life.
- **Holistic approach:** environmental, health and social sciences working together





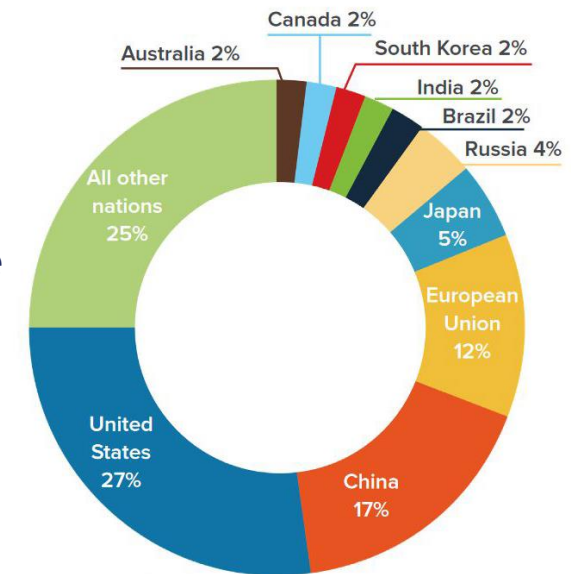
# Ecological footprint



- The area-projected measure of **biosphere transformation**.
- Shows, **how many land and water does a human society need** in a given technological developmental state for self-sustaining and for the absorption of produced waste.
- **Carbon footprint:** shows, how many greenhouse gases (GHG) are emitted directly and indirectly into the atmosphere through a **company** production, a **human** lifestyle or a **product** life cycle
  - Unit: t CO<sub>2</sub>e/year (emission based)
  - Makes a significant part of the ecological footprint → calculation, audit and mitigation strategies are the base of sustainability efforts
  - Measurement according to international environmental economical standards (f.e. life-cycle assessment, LCA)

# Carbon footprint of health care

- **Healthcare is a carbon-intensive sector:** its total global emissions are equal to those of the fifth largest greenhouse gas emitting country (Japan)
- **4,4% of global greenhouse gas emissions** (2 gigatonnes CO<sub>2</sub>e);  
**Hungary: 4,3%**
- **Biggest healthcare emitters: USA, China, EU** → 56% of global healthcare emissions
- **Share of dentistry** of the total carbon emissions of health care: **2-5%**



Healthcare Without Harm – Healthcare's Climate Footprint Report, 2019

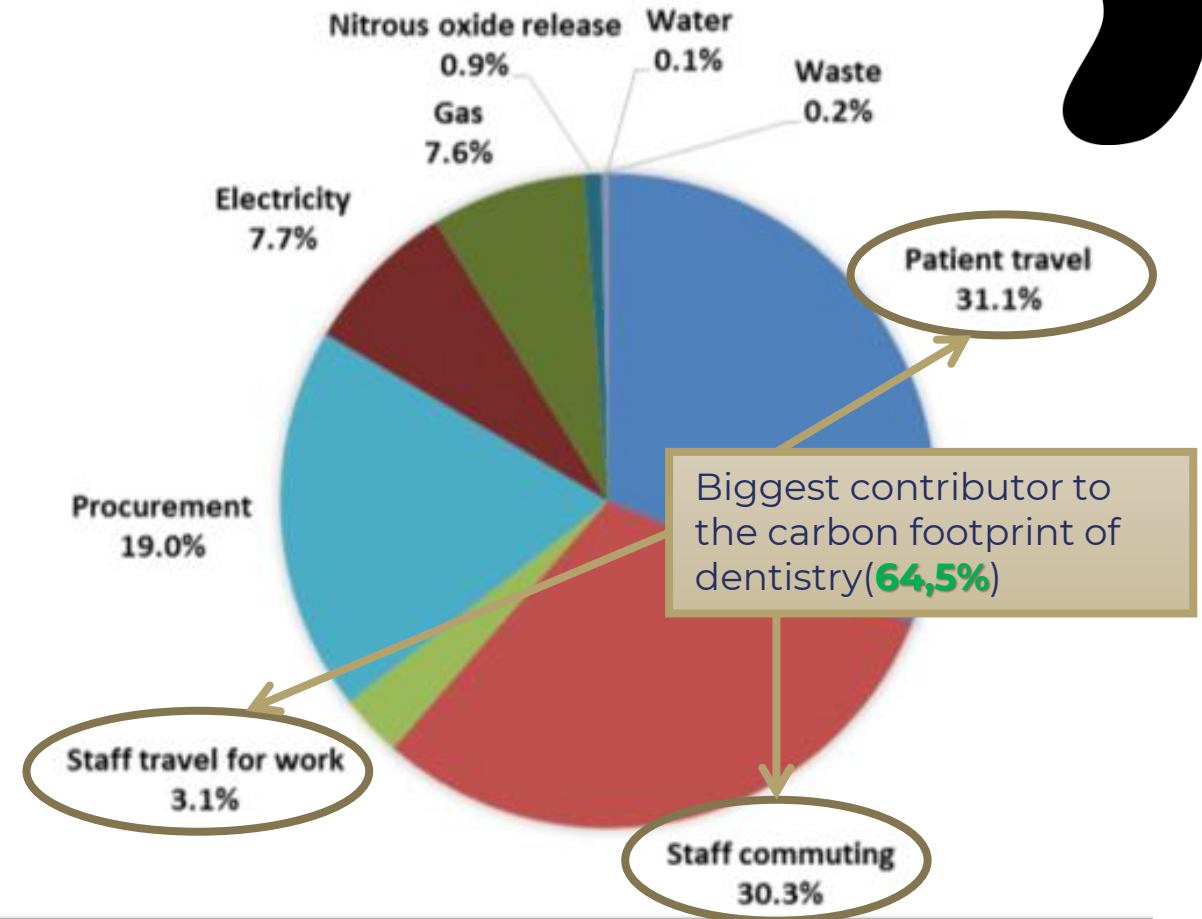
Bobvos, János és Páldy, Anna (2021) „Zöld egészségügy” – Célkitűzés és megvalósítási lehetőségek = “Green Health Care” – Aims and Ways to Realize. EGÉSZSÉGTUDOMÁNY : A MAGYAR HIGIÉNIKUSOK TÁRSASÁGA TUDOMÁNYOS ÉS TOVÁBBKÉPZŐ FOLYÓIRATA, 65 (4). pp. 37-48.

# Carbon footprint of dental care

Based on research in the publicly funded national health system in the UK (2014)



- Patient travel
- Staff commuting
- Staff travel related to work
- Procurement
- Energy use
- Water use
- Waste management



Duane B, Stancliffe R, Miller FA, Sherman J, Pasdeki-Clewer E. Sustainability in Dentistry: A Multifaceted Approach Needed. J Dent Res 2020;99(9):998-1003

# Sustainability challenges in dental care

- **High patient numbers - high volumes of travel**



- **Single-use plastics**



- **Toxic substances**



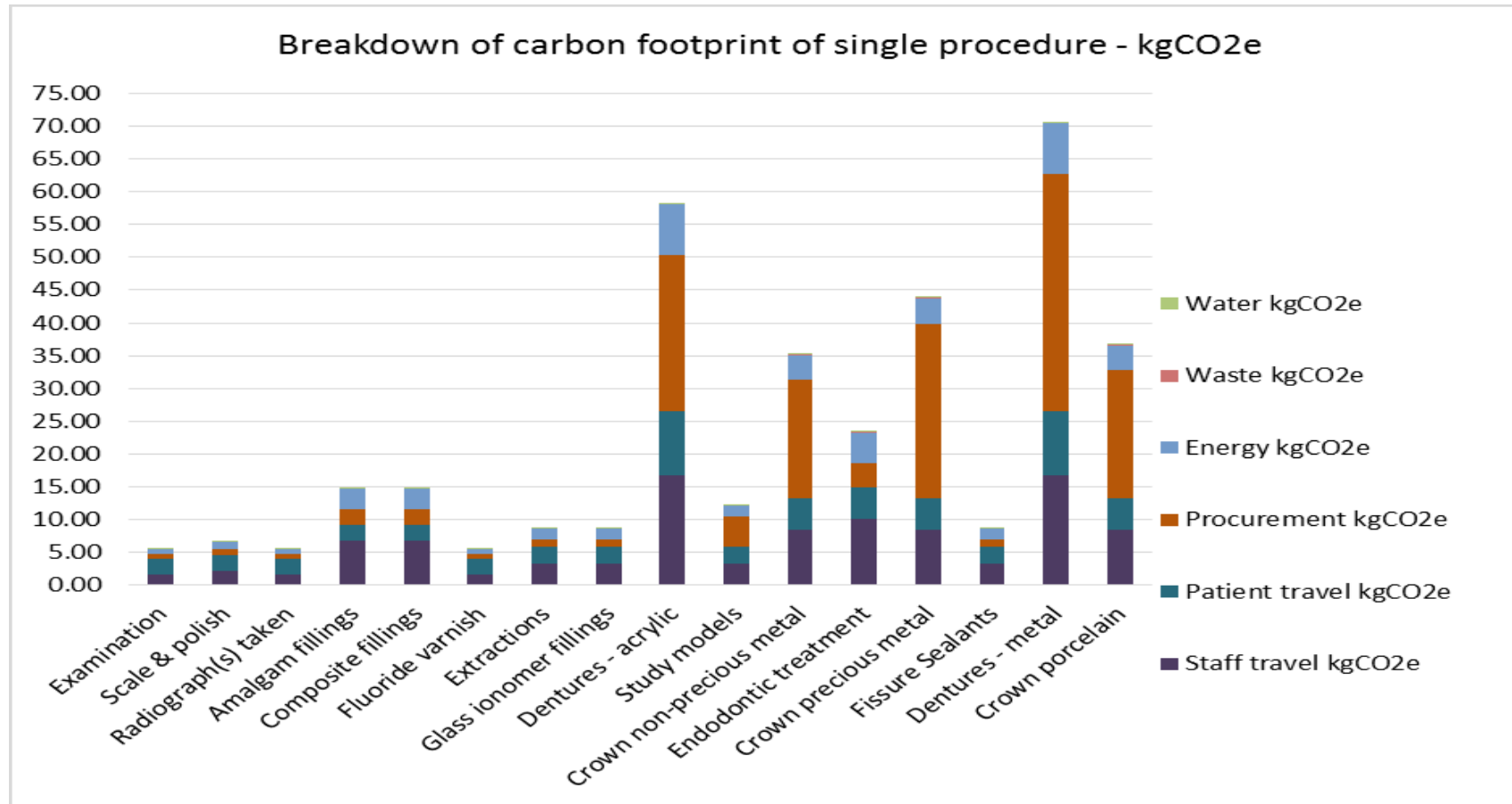
- **Energy and water consumption**



- **Waste generation and treatment**



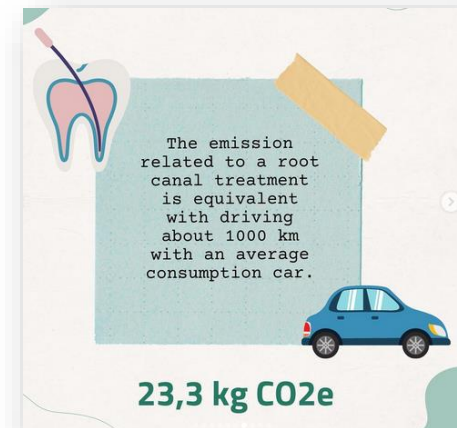
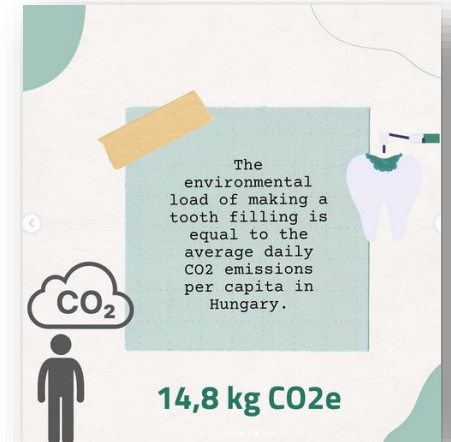
# Carbon footprint of dental interventions



Duane B, Stancliffe R, Miller FA, Sherman J, Pasdeki-Clewer E. Sustainability in Dentistry: A Multifaceted Approach Needed. J Dent Res 2020;99(9):998-1003  
Carbon modelling within dentistry: towards a sustainable future. Public Health of England, 2018.

# Carbon footprint of dental interventions

- Interventions with the smallest carbon footprints:
  - Dental examination (5,5 kg CO<sub>2</sub>e)
  - Scaling & polishing (6,5 kg CO<sub>2</sub>e)
  - Extraction, fissure sealing, glass-ionomer filling (all 8,6 kg CO<sub>2</sub>e)
  - Study models (12,1 kg CO<sub>2</sub>e)
  - Composite restoration (14,8 kg CO<sub>2</sub>e)
- Interventions with the highest carbon footprints:
  - Root canal treatment (23,3 kg CO<sub>2</sub>e)
  - Crown fabrication (35-44 kg CO<sub>2</sub>e, according to the type)
  - Acrylic removable denture (58,2 kg CO<sub>2</sub>e)
  - Denture with metal baseplate (70,5 kg CO<sub>2</sub>e)



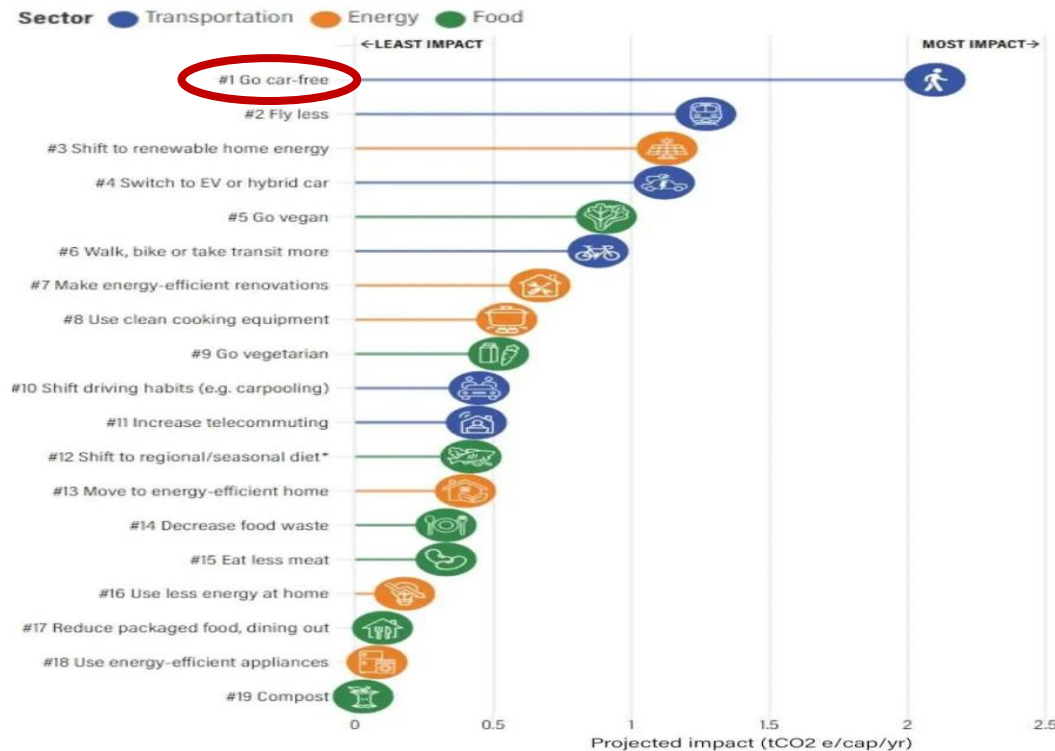
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# Decreasing the carbon footprint of dentistry – TRAVEL AND TRANSPORT

- The **largest contributor** to the carbon footprint of dentistry (**64,5%**) → patients, staff travel
- Characteristics of dental care: **outpatient services, large number of patients - many trips**
- **Dental tourism**
- **Possibilities of mitigation:**
  - Decreasing mobility needs – patient management and admission
  - Local patients
  - Remote consultations - Teledentistry
  - Decreasing distance between place of residence and dental office
  - Location of dental office and dental laboratory
  - Preference for environmentally friendly, active transport (walking, cycling, public transport, micro-mobility)

# Decreasing the carbon footprint of dentistry – TRAVEL AND TRANSPORT

## 19 climate-friendly choices, ranked



\*Such as a Mediterranean diet that includes less carbon-intensive red meat. Notes: These are meta-analytic estimates of greenhouse gas (GHG) reduction potentials for each behavior shift (in tons of carbon dioxide-equivalent per capita/year [tCO2e/cap/yr]), color-coded by sector. Data are from 659 estimates from 47 academic journal articles. In average, individuals emit 6.28 tonnes of CO2 equivalent (CO2e) per year. However, this average hides a vast disparity by country and income level. Wealthier, higher-consuming populations may emit up to 110 tonnes of CO2e per year, while lower-income groups may emit as little as 1.6 tonnes of CO2e per year. Source: WRI based on data from Ivanova et al. 2020.

 WORLD RESOURCES INSTITUTE

→ The carbon footprint of **active transport** is negligible!



# Decreasing the carbon footprint of dentistry – PROCUREMENT & SUPPLY CHAIN

- Responsible for **19%** of the total carbon footprint of dental care → **Environmental impact of the use of materials and equipment**
- **Linear** economy pattern
- **Global trade** externalities
- Long, complex **supply chains**
- Often **unethical working conditions**
- Polluting raw material **mining** and **production**



# Decreasing the carbon footprint of dentistry – PROCUREMENT & SUPPLY CHAIN

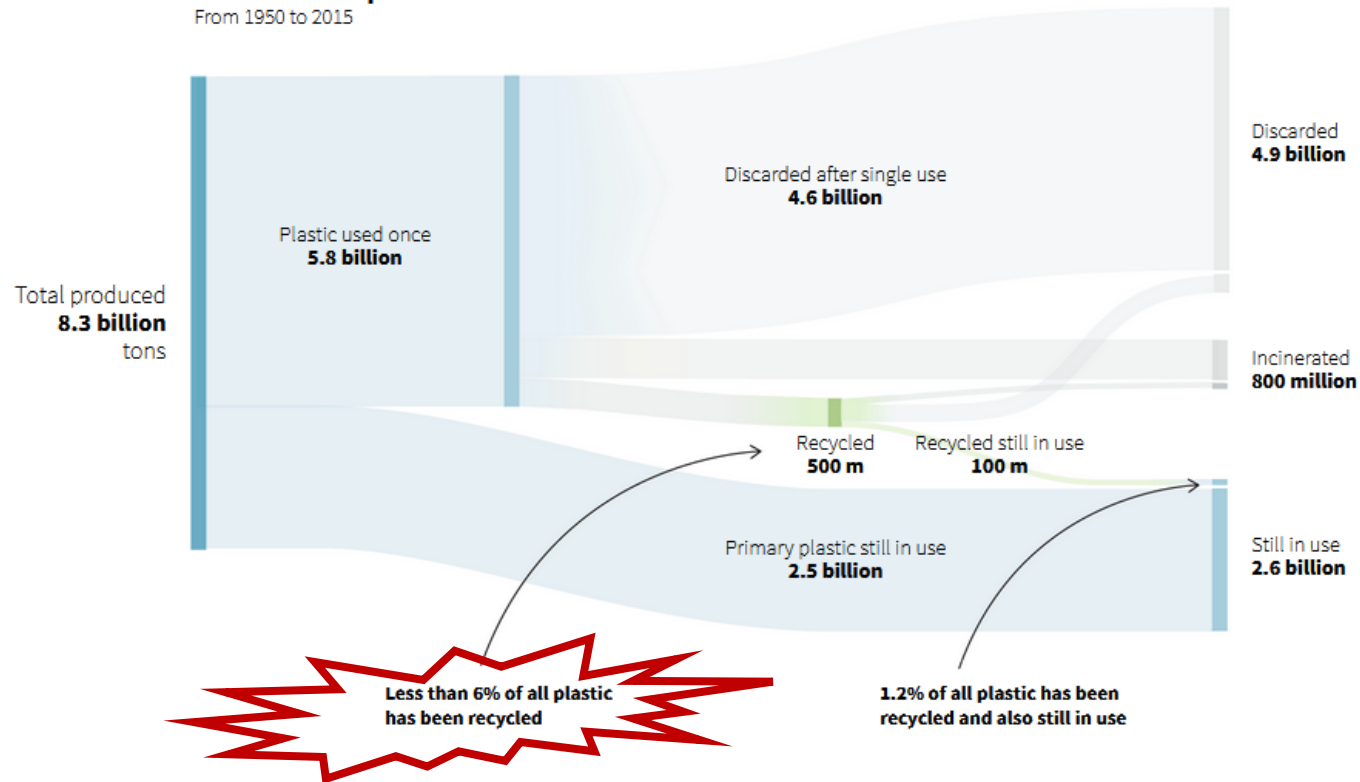
- „Green” (public) procurement → environmental sustainability (f.e.: collaboration with business partners committed to environmental friendly technologies)
- Ethical (public) procurement → social sustainability (f.e.: collaboration with companies committed to ethical production and trade)
- Decreasing and rationalizing consumption patterns → procurement restricted to those goods which is strictly needed
- Priorizing Local procurement sources (producers and distributors) → reducing delivery emissions; strengthening local economy
- Reduce Paper use → use of recycled papers and papers coming from sustainable resources; paper-efficient printing; digitalisation
- Using environmentally friendly, non-toxic chemicals
  - environmentally friendly **disinfectants** and **cleansing agents**
  - use of **digital radiography** instead of films
  - making **composite restorations** instead of amalgam



# Decreasing the carbon footprint of dentistry – PROCUREMENT & SUPPLY CHAIN

- Decreasing the use of Single-use plastics → supplementing with multiple-use, sterilizable or biodegradable alternatives

**The fate of all plastic**  
From 1950 to 2015

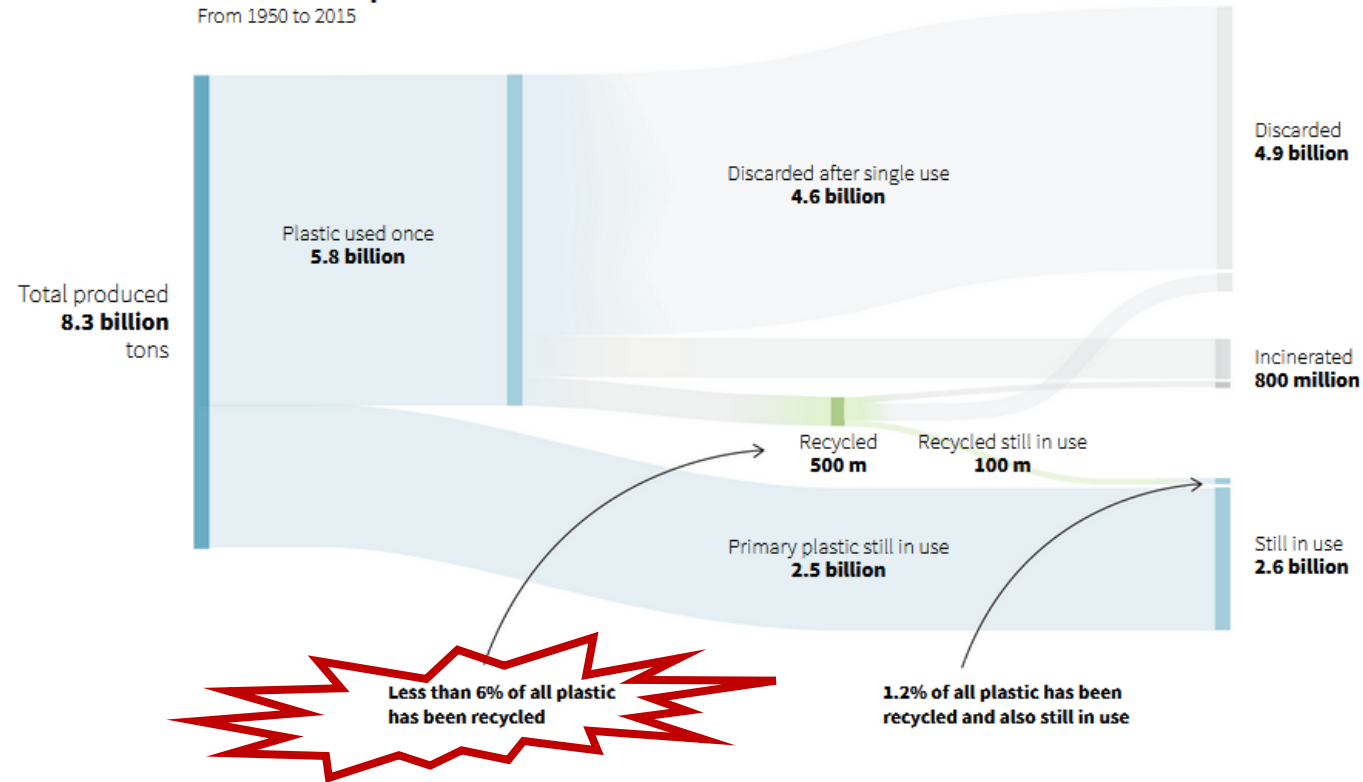


- Today, we produce about 400 million tonnes of **plastic waste** every year.
- Half of all plastic produced is designed for **single-use** purposes.
- 99% of plastics come from **fossil fuels**

# Decreasing the carbon footprint of dentistry – PROCUREMENT & SUPPLY CHAIN

- Decreasing the use of Single-use plastics → supplementing with multiple-use, sterilizable or biodegradable alternatives

**The fate of all plastic**  
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# Decreasing the carbon footprint of dentistry – PROCUREMENT & SUPPLY CHAIN

- Decreasing the use of Single-use plastics → supplementing with multiple-use, sterilizable or biodegradable alternatives



# Decreasing the carbon footprint of dentistry – PROCUREMENT & SUPPLY CHAIN

- Decreasing the use of Single-use plastics → supplementing with multiple-use, sterilizable or biodegradable alternatives

✓Rinsing cups



✓Saliva ejector and exhaustor



✓Instrument trays

✓Patient bibs



✓Protection gowns



✓Syringes



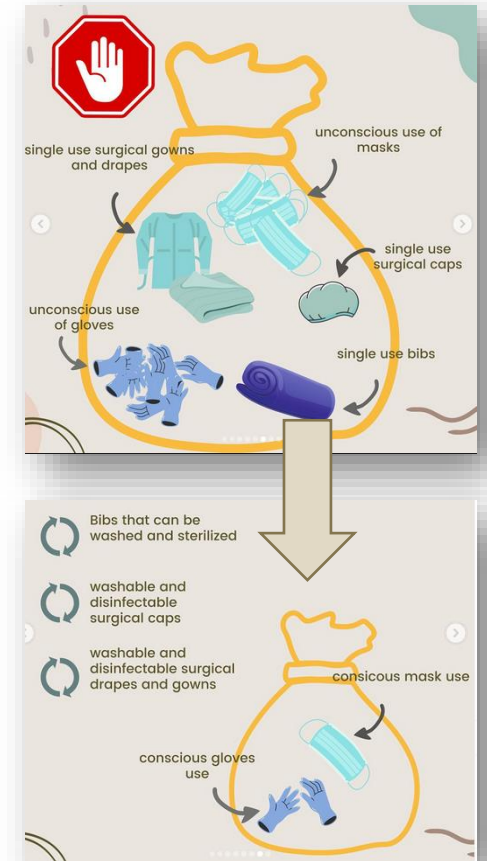
✓Sterilisation pouches

✓Home oral healthcare products



# Decreasing the carbon footprint of dentistry – PROCUREMENT & SUPPLY CHAIN

- Decreasing the use of Single-use plastics → supplementing with multiple-use, sterilizable or biodegradable alternatives

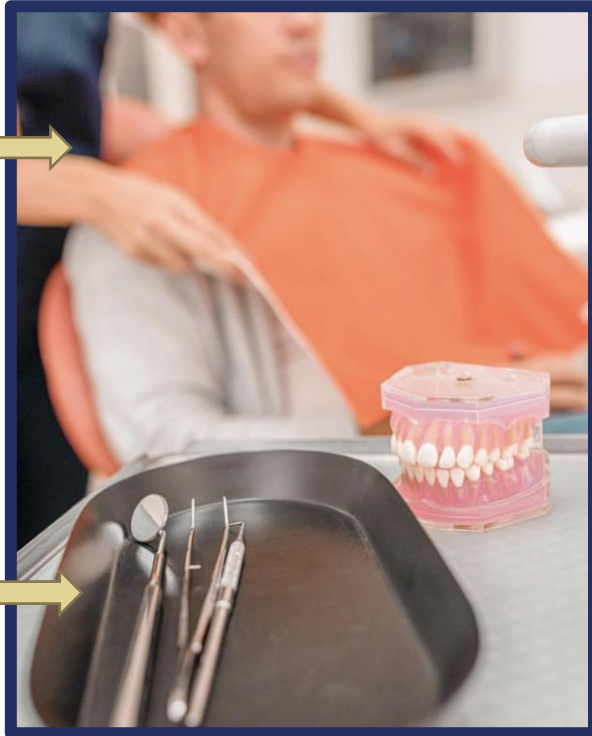


# Single-use plastics in dentistry and their supplementation possibilities



Single-use bi-layered PP, PE or PLA paper-plastic patient bib

Reusable, sterilisable textile patient bib



Reusable, sterilisable metal instrument tray



Single-use PS instrument tray



Single-use Luer-type plastic syringe



Reusable, sterilisable Carpule-type syringe with cylinder-ampoule



Single-use PP / PS rinsing cup



Own cup

# Decreasing the carbon footprint of dentistry – ENERGY USE

- **Energy use** accounts for **15%** of the total carbon footprint of dental care
- → electricity, heating, warm water production, built infrastructure
- **Possibilities for mitigation:**
  - Use of **renewable energy sources** (solar, geothermal, heat pumps)
  - Building **energy management systems** – according to the use of rooms
  - **Energy saving** → switching off lights, turning off equipment after use
  - **Energy efficiency** → building insulation; windows; HVAC systems, air conditioning & heating; programmable thermostats; dental vacuum pumps & compressors; LED lighting; modern energy-efficient devices



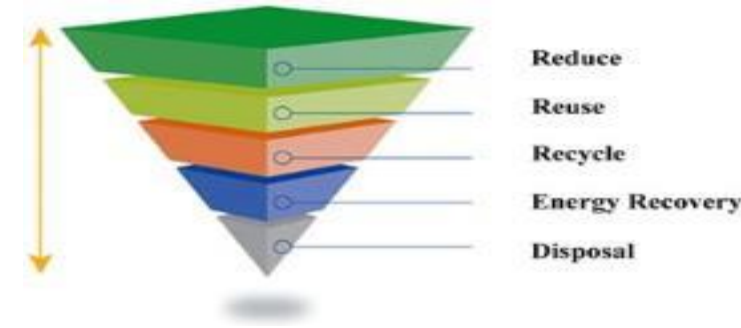
# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

- Healthcare waste management accounts for a smaller part of the carbon footprint of dentistry → **production and supply chain of the used resources are responsible for 90% of their carbon footprint**
- **Globally 5.9 million tonnes of healthcare waste** is produced annually; in Hungary 80.000 tonnes
- About 15% of the total healthcare waste stream is **hazardous healthcare waste requiring special treatment**
- Treatment of special hazardous healthcare waste → **excessive energy use, costs and environmental load**
- **Pillars of effective waste treatment:**
  - Preventing waste generation
  - Segregating waste properly
  - Regular control – „waste audit”

# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

## 3 R / 4R principle: Rethink; Reduce; Reuse; Recycle

- **STEP 0: Conscious procurement and resource use; oral health prevention (Rethink)**
- **Decreasing non-necessary dental interventions (Reduce)**
- **Reuse** → circular economy for resources
  - Using reusable, durable devices
  - Refurbishment, reprocessing
  - Donating or selling products which are no longer in use → social and environmental sustainability
- **Recycle** → waste segregation



# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

**Healthcare waste:** Waste generated at healthcare providers during their services containing human or animal biological products

- **Hazardous healthcare waste:** those healthcare waste which are classified as dangerous waste
  - **Special biohazardous healthcare waste**
    - Contaminated sharp instruments which can cause needle-prick accidents or could be contaminated with microorganisms
    - Waste from blood derivatives or containing biological remnants
    - Single-use devices contaminated with blood



# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

- **Special biohazardous healthcare waste**

- Transport requirements **ADR** (European Agreement concerning the International Carriage of Dangerous Goods by Road)
- Hazardous waste generated in healthcare facilities **can be stored for 2 days, or 30 days if refrigerated storage is possible.**
- **Infectious waste generated during treatment activities must be collected in certified, single-use collection containers!**



- **Materials slightly contaminated with blood, secretions, bandages, dressings, fastenings, disposable clothing, sheets, tampons, patient care waste (if the moisture content of the waste is up to 10%)**

**yellow ADR certified plastic (not PVC) bags**

After they are full, the mouth of the bag must be tied closed, i.e. sealed permanently, and the data plate on the side of the bag must be filled accurately

- **Sharps:**

→ **needle holder, rigid-walled plastic container, impregnated cardboard box**



Semmelweis Egyetem Környezetvédelmi Szabályzat, 2020

# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

- **Main sources of special biohazardous healthcare waste in dentistry:**



❖ **Infection control barriers, Personal Protective Elements (PPE)** (protective barriers, gloves, masks, face shields, caps, shoe covers, aprons, gowns, etc.)



❖ **Patient care waste and sundries** (instrument trays, bibs, aspirator tips, rinsing cups, cotton rolls, wipes and paper towels, applicator tips, mixing tips, syringes, impression materials, gypsum casts, etc.)



❖ **Sterilisation pouches/ wraps** → the clean paper and plastic layers could be separated and collected selectively!

# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT



## AMALGAM & MERCURY WASTE MANAGEMENT

- Problem: dental suction units → sewer system → water pollution, environmental mercury load → [Minamata treaty \(2017\)](#)
- Making of dental amalgam restorations are **forbidden** in deciduous teeth, under 15 years and in pregnant (since 2018.07.01)
- [Amalgam separators](#) → **Obligatory** in those offices, where amalgam restorations are placed or removed in Hungary (since 2019.01.01); **95% retention efficiency** is needed (since 2021.01.01)
- In Hungary, the **complete phase-out of amalgam restorative materials is projected to 2030** (2017/852 EU Directive)

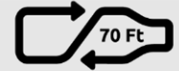


# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

## SELECTIVE WASTE COLLECTION

- Municipal solid waste (paper; plastic&metal; glass; organic waste)
- Chemical/physical hazardous waste (used or expired chemicals; packaging of chemicals and disinfectants; pharmaceutical waste; electric waste; toners; cartridges; batteries; lamps etc.)
- Special biohazardous healthcare waste → **separate collection and labelling in clinical wards** according to guidelines!

**Non-hazardous, non-contaminated waste** thrown into special biohazardous waste collectors unnecessarily increases the amount of hazardous waste and the associated costs and environmental load!



# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

## SELECTIVE WASTE COLLECTION

- Non-hazardous, non-contaminated waste thrown into special biohazardous waste collectors unnecessarily increases the amount of hazardous waste and the associated costs and environmental load!
  - 2-3 times increase in **costs** due to special transport
  - **carbon footprint** of incineration disposal is much higher
- **Shortcomings in the separation** of both municipal and clinical waste



Runcie H. Sort your waste! An audit on the use of clinical waste bins and its implications. Future Healthc J 2018;5(3):203-6.

Duane B, Ramasubbu D, Harford S, Steinbach I, Swan J, Croasdale K, Stancliffe R. Environmental sustainability and waste within the dental practice. Br Dent J. 2019 Apr;226(8):611-618.

# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT



## INCINERATION OF HEALTHCARE WASTE

- Waste incineration facilities are sources of heavy air pollution → **release of toxic materials into the air**: dioxines, furanes, heavy metals, organic combustion products → **health + environmental risks!**
- Combusting healthcare waste was the highest source of **dioxine pollution** in the United States
- **New, stricter emission thresholds**: USA (1997), EU (2000) → modern filters
- **In Hungary**, the management of dangerous healthcare waste is regularly done by combustion.
- **Most efficient** way of waste management in terms of infection control, however, the **most expensive and pollutant** at the same time → **importance of conscious use of special biohazardous waste bins!**

# Decreasing the carbon footprint of dentistry – WASTE MANAGEMENT

## NON-COMBUSTION TECHNOLOGIES FOR HEALTH CARE WASTE

- **WHO directive (2014)** → non-combustible technologies should be prioritised as the long-term goal for the final management of healthcare waste
- **Technologies:** Thermic (steam sterilization, microwave); Chemical (chlorine and non-chlorine); Irradiation (ionising radiation); Biological (enzymatical degradation)
- **No technologies are available for the complete environmentally friendly management of healthcare waste so far...**





Thank you for your  
attention!



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