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

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

Past and present

- 2600 B.C. : The first known dentist was an Egyptian named Hesi-Re
- 500-300 B.C.:

Hippocrates and **Aristotles** wrote about dentistry, including the eruption pattern of teeth, treating decayed teeth and gum disease, extracting teeth with forceps, and using wires to stabilize loose teeth and fractured jaws.

- 700-510 B.C.

Etruscan period of dentistry. Some twelve examples of their **fixed or removable bridgework** have been preserved in various museums

- 25 B.C. - 50 A.D.
- **Celsus** He 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

- **The Barber-Surgeons**
- At the onset of the Middle Ages the **monks** became physicians and dentists. Barbers had acted as assistants to the monks.
- When the pope in 1163 ruled that any operation involving the shedding of blood was incompatible with the priestly office, the **barber** took over the practice of Surgery.
- They plied their trade in public squares.
- In France in 1700 anyone desiring to practice oral surgery and restorative dentistry had to take a regular prescribed examination

Modern dentistry

- The French surgeon **Pierre Fauchard** known as the "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 maker, jewelers that he thought could be used in dentistry.
- Publishes The Surgeon Dentist, A Treatise on Teeth (**Le Chirurgien Dentiste**): basic oral anatomy and function, operative and restorative techniques, and denture construction

- **1840**

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

Specialities

- 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

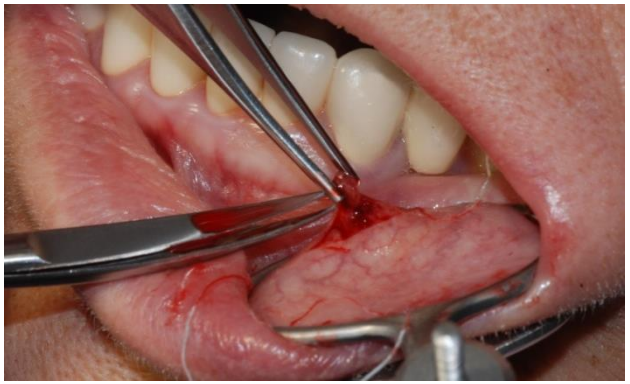
- concerned with the study and **treatment of malocclusions** (improper bites), which may be a result of tooth irregularity, disproportionate jaw relationships, or both. Orthodontic treatment can focus on dental displacement only, or can deal with the control and modification of facial growth.

Oral Surgery

Dento-alveolar surgery

maxillo-facial surgery

- It includes the 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

- is the specialty of dentistry that 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

- Prosthodontics is the 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

Pedodontics

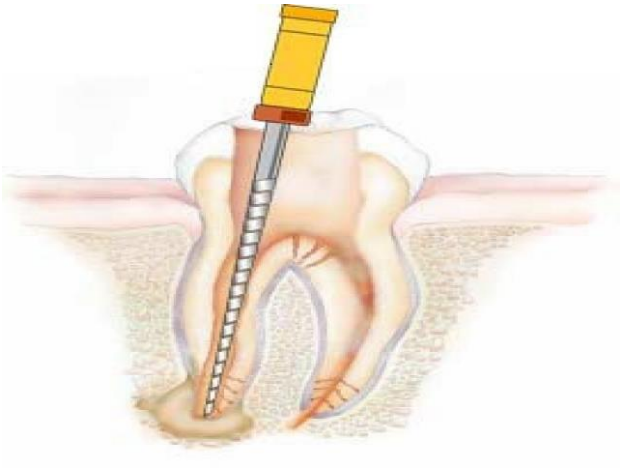
- This discipline focuses on pediatric/adolescent growth and development, disease causality and **prevention**, child psychology and management, and all aspects of the highly-specialized Pediatric restorative techniques and modalities.

Oral Pathology

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

Endodontics

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



The dental team

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

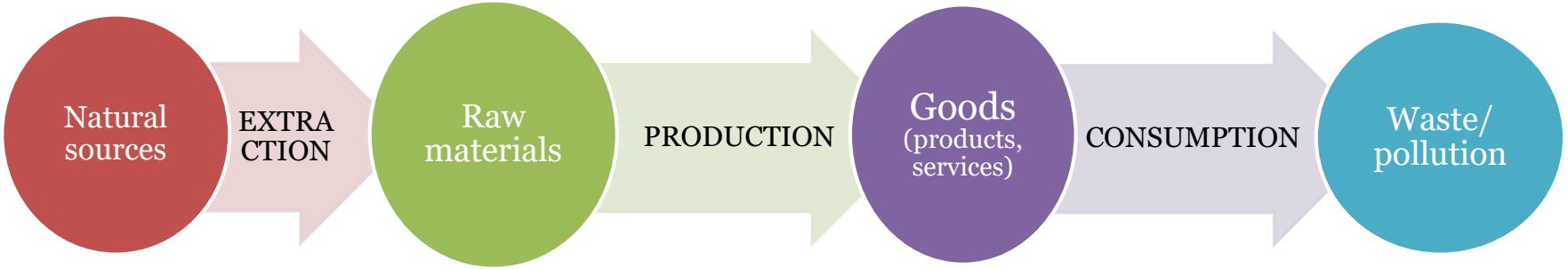
PART II.

Environmental aspects in dentistry.

Ecological footprint of dental treatments. Sustainability in dentistry and dental waste management.

Why is this topic important?

- **We are living in an ecological crisis!**
- Reason: Major and fast 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

- United Nations – Bruntland Report (1987)
- **Developmental process which fulfills the needs of the current generation, without sacrificing the ability of the future generations to fulfill their own needs.**

- Pillars of sustainability: „three-legged chair”model

FDI (World Dental Federation) political statement of sustainability in dentistry (2017) – most important points:

- Priorizing primary **prevention** in patient care
- Sustainable **good practices** in the dental office – for high quality and secure patient care
- Mitigation of **consumption** (energy, water, paper)
- Environmental aspects in **procurement** – e.g. single-use vs. Multiple-use materials and tools
- Commitment to sustainability of **dental industry** – eco-efficient technologies and materials
- Continuous **education** of sustainability by professional organizations

Barriers of environmental sustainability in dentistry *(based on de Leon et al)*

- Infrastructural → properties of the built environment; municipal infrastructure; production and procurement chains

- Institutional → special rules of infection control in healthcare facilities versus municipal waste segregation methods

- Educational → gaps of educationg sustainability; lacking knowledge in waste management, environmental protection and ecology

- Individual→ time constraints; restricted knowledge; lack of awareness or interest

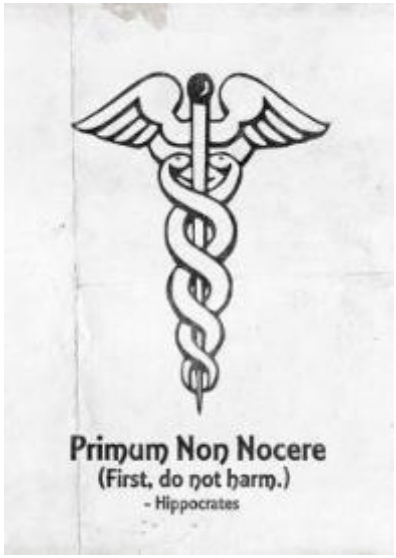
de Leon ML. Barriers to environmentally sustainable initiatives in oral health care clinical settings. Can J Dent Hyg 2020;54(3):156-60.

Ecological footprint

- The area-projected measure of biosphere transformation.
- 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_2e/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)

Ecological footprint of healthcare

- Healthcare actually cannot be regarded as sustainable in an ecological point of view
- *Globally,* healthcare sector is responsible for **5% of the GHG emissions** of all of the countries; in the USA 10%, in Hungary 4.3%
- Increasing social and economical demand for estabilishing more sustainable healthcare systems



Ecological footprint of dentistry

- **Most important,measurable inputs of dental ecological footprint:**
  - Staff commuting to work
  - Staff travel related to work
  - Patient travel
  - Procurement
  - Energy use
  - Water use
  - Waste management

- Using the upper mentioned inputs we are able to determine the ecological footprint of dental treatments

Ecological footprint of dentistry

- *Duane et al (Centre for Sustainable Healthcare)* → Calculated the carbon footprint of the NHS-funded public dental care in England between 2013 and 2014, and made evidence-based suggestions for its mitigation and transforming dentistry into a sustainable way

CENTRE *for* SUSTAINABLE HEALTHCARE
inspire • empower • transform

- Applied methods: hybrid analysis → lifecycle assessment + environmental input-output analysis

Ecological footprint of dentistry

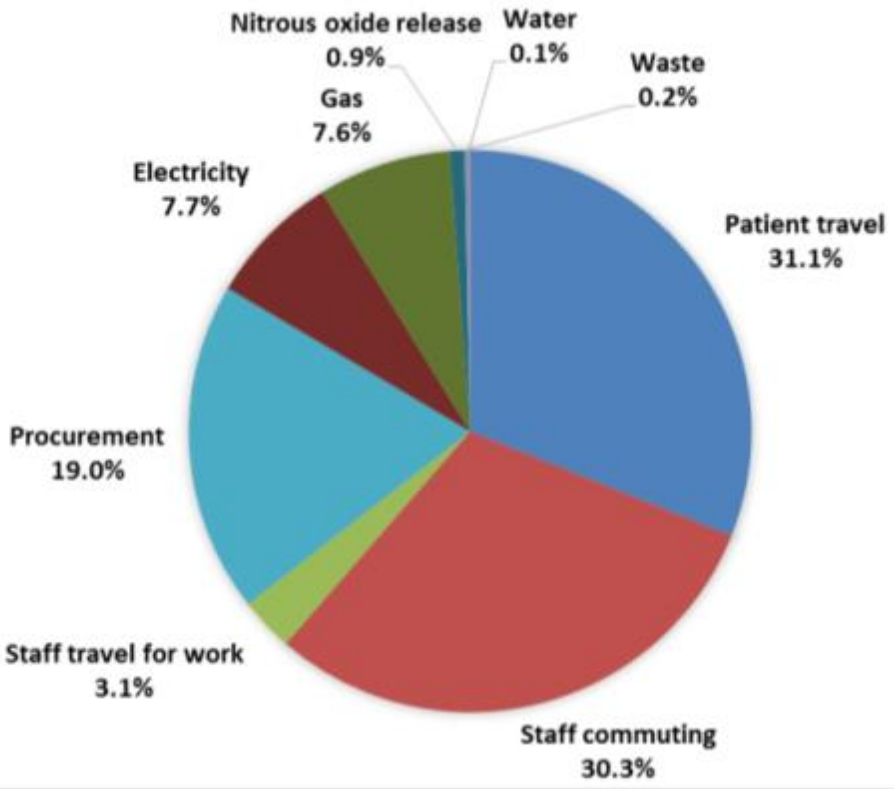
- Dental care takes part of the total healthcare carbon footprint by 3% (675 kt CO2e) in England.

Main emitters	Community emitters	Emitters of procurement chain
• Energy use • Material use • Water use • Waste management • Travel related to work	• Patient travel • Staff commuting • Household oral hygiene	• Production • Distribution • Procurement • Infection control protocols

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.

Main contributors to the carbon footprint of dentisrty

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



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Decreasing the carbon footprint of dentistry

- **Travel** takes **64,5%** of the total carbon emission of dentistry! → patient travel + staff commuting
- Possibilities for mitigation:
  - Reduce Travel needs by optimizing patient attendance to visits
  - Reduce the Distance between home and workplace
  - Location of Dental office and dental lab
  - Use and support Sustainable methods of travel : walking, cycling, public transport, etc.

→ The carbon footprint of active transport is negligible!

Decreasing the carbon footprint of dentistry

- **Procurement (Supply chain)** is responsible for **19%** of the total carbon footprint of dentistry (in helathcare:58%!) → procuring goods and services, including sustainability aspects of their production
- Possibilities for mitigation:
  - „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)
  - Comprehensive stock management and purchasing
  - Priorizing Local procurement sources (producers and distributors) → reducing delivery emissions; strengthening local economy

Decreasing the carbon footprint of dentistry

- **Procurement (Supply chain)** is responsible for **19%** of the total carbon footprint of dentistry (in helathcare:58%!) → procuring goods and services, including sustainability aspects of their production
- Possibilities for mitigation:
  - Reduce Paper use → use of recycled papers and papers coming from sustainable resources; paper-efficient printing; digitalisation
  - Reduce use of Single-use Plastics → supplementation with multiple-use, sterilizable or biodegradable alternatives
  - Environmentally friendly, non-toxic chemicals → environmentally friendly desinfectants, cleansing agents; use of digital radiography instead of films; making composite restorations instrad of amalgam etc.

Decreasing the carbon footprint of dentistry

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

✓ Saliva ejector and exhaustor

✓ Patient bibs

✓ Rinsing cups

✓ Protection gowns

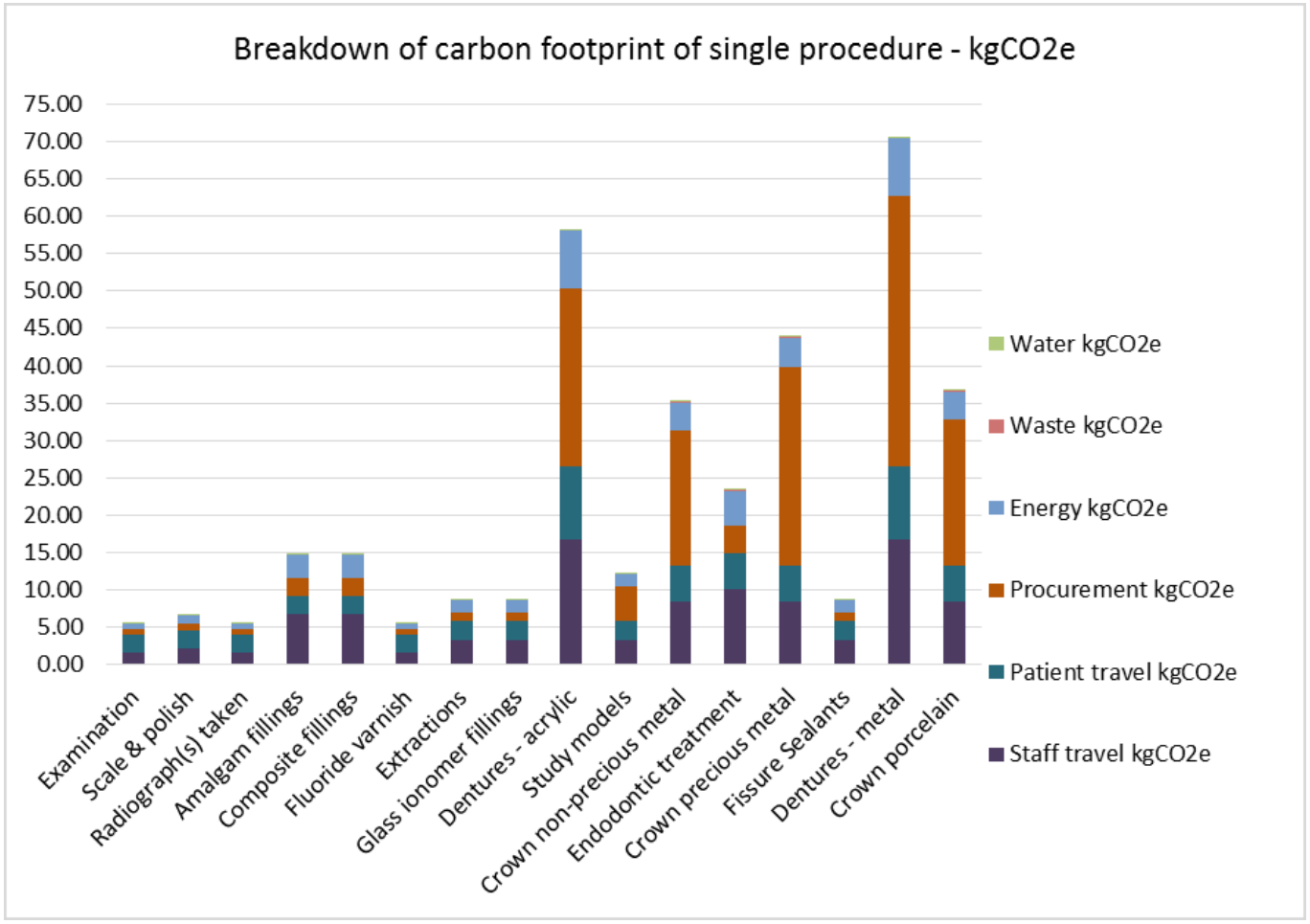
✓ Syringes

✓ Household oral healthcare products

Decreasing the carbon footprint of dentistry

- **Energy use** is responsible for 15% of the total carbon footprint of dentistry → electricity, heating & cooling, warm water production
- Possibilities for mitigation:
  - Use of individual, renewable energy sources → solar panels, heat pumps etc.
  - Energetical management– estabilishing room sizes according to expected loading
  - Energy saving → turning off lighting and appliances when not in use, etc.
  - Energy efficiency→ building insulation; doors and windows; heating, warm water producing, ventillation and air conditioning systems; programmable thermostats; dental vacuum pumps and compressors; LED lighting; energy-efficient devices

Carbon footprint of some dental treatments and their contributors



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Carbon footprint of some dental treatments

- **Treatments with the smallest carbon footprint:** dental examination (5,5 kg CO_2e) < scaling & polishing (6,5 kg CO_2e) < tooth extraction; fissure sealing; glass-ionomer filling (all 8,6 kg CO_2e) < study cast fabrication (12,1 kg CO_2e) < composite filling (14,8 kg CO_2e)

- **Treatments with the highest carbon footprint :** root canal treatment (23,3 kg CO_2e) < crown making (35-44 kg CO_2e, according to type) < acrylic removable dentures (58,2 kg CO_2e) < dentures with cast metal baseplate (70,5 kg CO_2e)

- A single dental treatment has a very small carbon footprint ← → All dental examinations in the year of measurement are responsible for up to 27% of dental carbon footprint!

Waste management in dentistry

- Waste is responsible for only a very small amount of dental carbon footprint → reason: production and procurement takes 90%of the carbon footprint of goods!

- Pillars of effective waste management:

  - **Preventing waste generation**
  - **Segregating waste properly**
  - **Regular control – „waste audit”**

Waste management in dentistry - prevention

- **3 R / 4R principle!**
- **Conscious purchasing & reduction of consumption (Rethink) → 0. Step!**

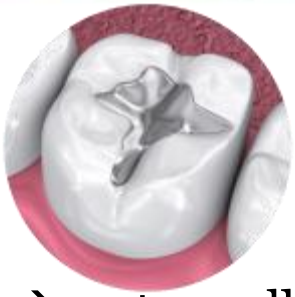
- **Reduce**: water use, paper use
- **Reuse**, if possible
  - Use of multiple-use goods and products where possible
  - Donating or selling products which are no longer in use → social and environmental sustainability!
- **Recycle** → selective waste collection!

Waste management in dentistry - collection

- **Selective waste collection:**
  - Collection of non-dangerous municipal waste in every room (paper, plastic, glass, metal, compost)
  - Separate collection and delivery of Dangerous electric waste

  - Separate collection of non-dangerous and dangerous healthcare waste in clinical wards; separate collection of pharmaceutical waste based on correct labelling
    - **Prevention of throwing non-contaminated waste into dangerous healthcare waste!**

Waste management in dentistry – amalgam waste



- Problem: dental suction units → sewer system → water pollution; environmental mercury load → Minamata treaty (2017)
- From 2018.07.01: making of amalgam restorations are forbidden in milky teeth, under 15 years, in pregnants

- Amalgam separators → From 2019.01.01: **Obligatory** in those offices, where amalgam restorations are placed or removed in Hungary
- From 2021.01.01: **95% retention efficiency** is needed!

- In Hungary, the complete eradication of amalgam restorative materials is projected to 2030

Collection of healthcare waste

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

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

Collection of healthcare waste

- Only **15%** of the complete waste generated in healthcare is regarded as dangerous and deserves special collection → With effective waste segregation systems this can be **reduced to 3-5%**
- Non-dangerous waste thrown into special dangerous waste collectors unnecessarily increases the quantity of dangerous waste!

- Runcie et al (2018) → according to waste audits done in british hospitals, **59% of the waste thrown into special dangerous waste collectors was thrown in unnecessarily**!

- Gaps in the knowledge of healthcare personnel regarding segregation of clinical waste → need of education and awareness raising

Management of healthcare waste with combustion

- Waste combustion facilities are sources of heavy air pollution → 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
- Determining 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 waste segregation!

Non-combustion technologies for the management of healthcare waste

- **WHO directive (2014)** →non-combustible technologies shoud be the long-term goal during the final management of healthcare waste

- **Technologies**: Thermic (steam sterilization, microwave); Chemical (chlorine and non-chlorine); Irradiation (ionising radiation); Biological (enzimatical degradation)

- **No technologies are available for the complete environmentally friendly management of healthcare waste so far…**

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Thank you for your attention!