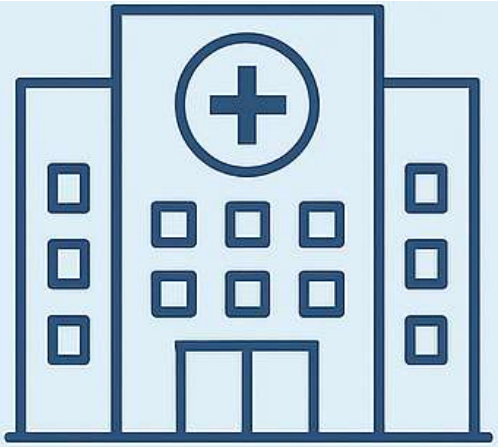
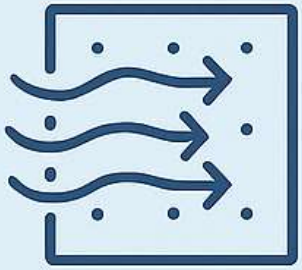
VENTILATION in Hospitals



According to CEN/TC 156 Working group 18

VENTILATION REQUIREMENTS

Specified for rooms in healthcare facilities



AIR FILTRATION

Start presentation

M of air filters for different applications

PERFORMANCE TESTS

Procedures for verification of hygiene & performance

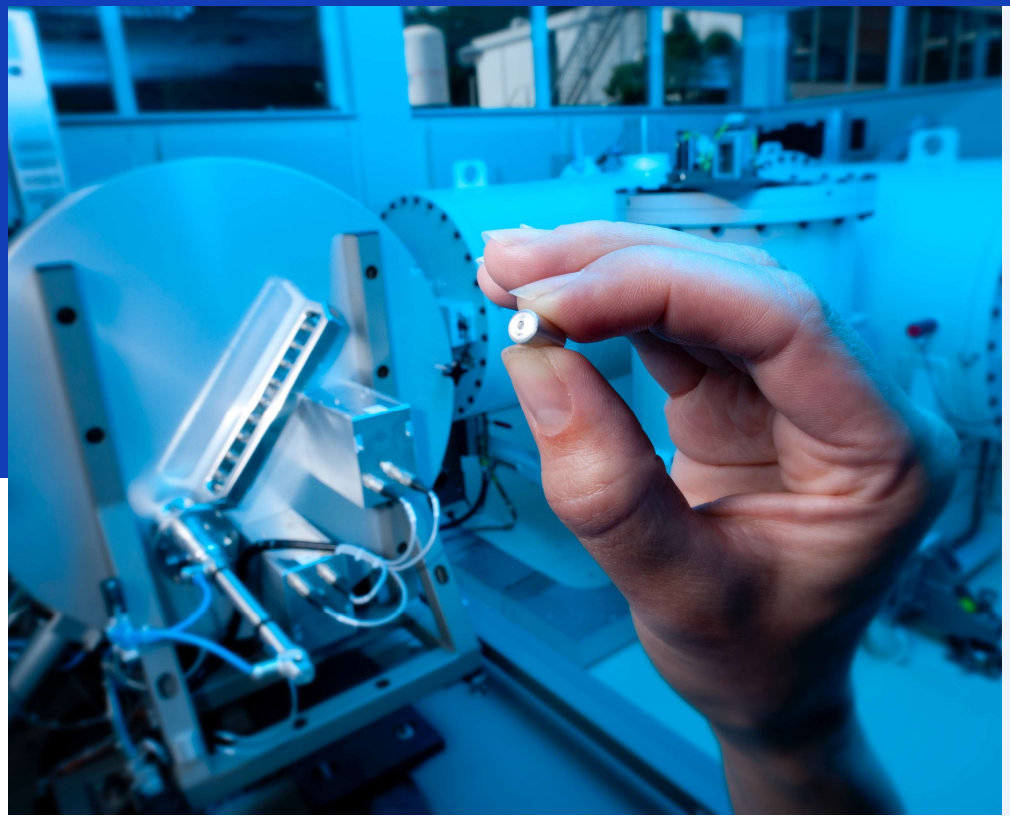
Disclosure

Dr. Roberto Traversari. MBA

I have the following potential conflicts of interest to report:

- ❑ Consulting
- ❑ Employment in industry
- ❑ Stockholder of a healthcare company
- ❑ Owner of a healthcare company
- ❑ Other(s)
- ✓ I do not have any potential conflict of interest

Agenda



1. Ventilation from different perspectives
2. Energy use
3. Discussion

Different point of view for indoor air quality from a climate change perspective

- Hospital acquired infections
- Social cost associated with indoor air pollution
- Pandemic Preparedness
- Energy/CO_2-emissions

Standardisation to prevent hospital acquired infections

There is a strong need for standardisation of requirements for air quality in hospitals:

- Due to historical developments, countries have their own approaches; This means that even between neighboring countries, the approach can differ completely
- Not all countries have their own requirements and guidelines
- Some countries have national standards
- Some countries protect their own industries
- It is difficult for suppliers to be active in different European countries due to different requirements, guidelines and approaches

SCOPE of our work

It applies to all medical locations where healthcare services are delivered.

The TS provides defined levels of air quality/cleanliness and comfort for these areas and addresses the requirements for ventilation systems.

It specifies the design, installation, operation, verification process, maintenance and reverification of the ventilation systems (user requirement specification, functional design requirements, requirements for components in the detailed design).

The TS describes the following hygienic issues related to the ventilation system:

a) protection of **patients**, **staff** and **visitors** against biological and other harmful agents;

b) reducing the growth of microorganisms (e.g. clean-ability, accessibility, wet surfaces, accumulation of particles);

c) air quality (e.g. cleanliness levels, temperature, humidity, air quantity, thermal comfort);

d) control of the airflow direction (e.g. tightness of systems and constructions, pressure difference).

The TS is intended for project managers, designers, construction and commissioning engineers, estates managers and operations/facilities managers.

Program Pandemic Preparedness through ventilation

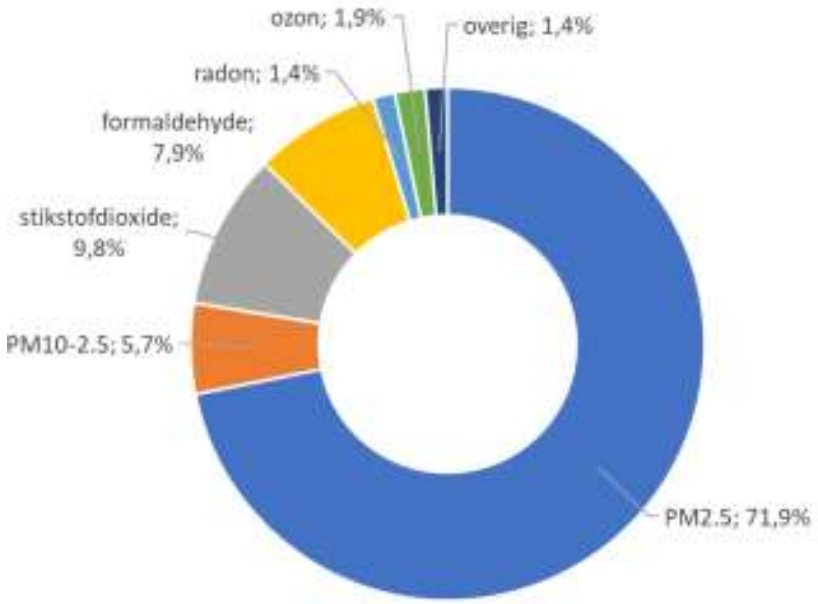
Main recommendations:

- No natural ventilation in spaces where vulnerable people are together for long periods of time
- Consider the airborne transmission route for respiratory viruses even if “no viruses” are measured in the air
- Create a database of inactivation characteristics of known respiratory viruses. The effect of environmental conditions (T, RH, CO_2-concentration, mucus, etc.) on virus inactivation remains largely unknown.
- At low ventilation rates there is no homogeneous mixing in a room
- Use transparent and explicit decision-making models
- For a room, indicate how many people it is designed for from a ventilation perspective

Social cost associated with indoor air pollution

Percentage contribution of indoor air pollutants to the disease burden in the Netherlands:

- Estimation of total social cost associated with indoor air pollution in the Netherlands **EUR 7.8 billion per Year**
- 80% of the time people spend indoors (west Europe)
- Fine dust makes the largest contribution to social costs (71,9%)
- Building code only provides requirements for design flow rates and not for indoor AirQuality

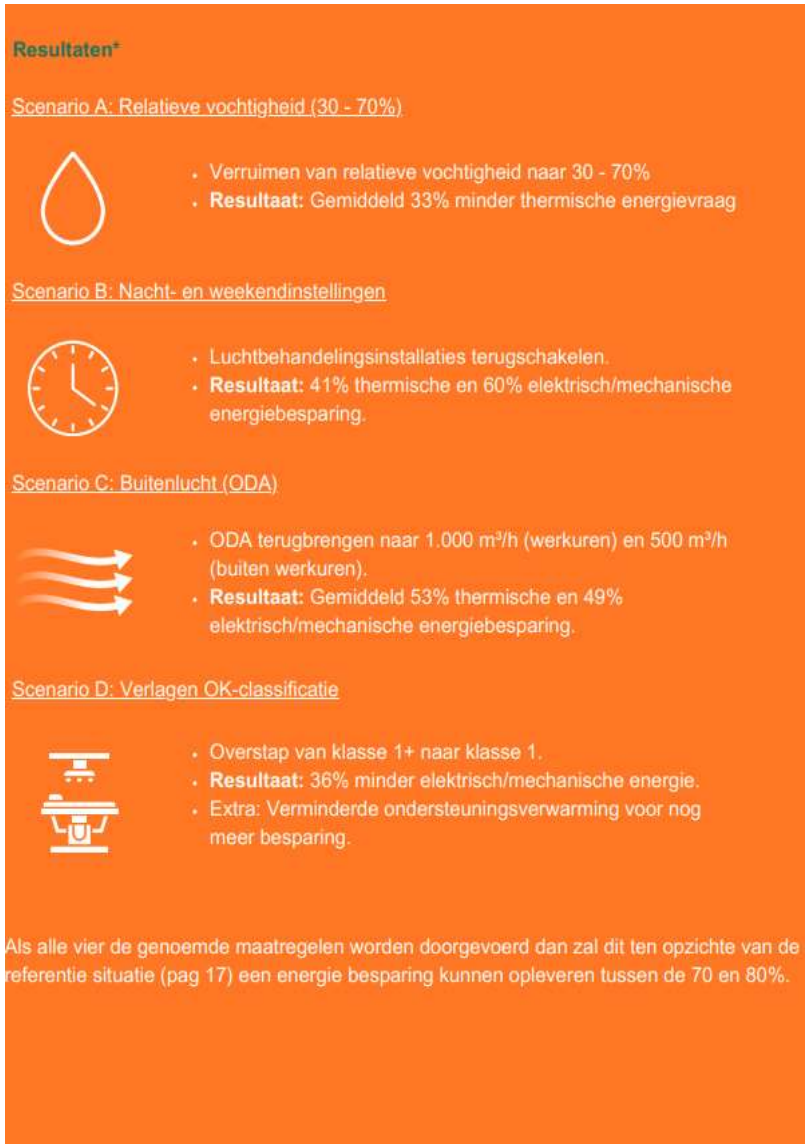


Reference: https://publications.tno.nl/publication/34644187/ez9GNZrq/traversari-2025-goede.pdf

Energy consumption

Energy consumption ventilation in hospitals:

- In Europe ventilation is responsible for 20-35% of the energy use of hospitals (RES-Hospitals project)
- In the OR ventilation is responsible for 70-90% of the energy use of the department
- For patient rooms and wards often the building code is applicable, in practice a ventilation rate of 1 – 6 $^{-h}$ is often used
- For OR often a separation between general OR and Ultra Clean OR is used with a ventilation rate of > 20^{-h}
- In OR up to 80% energy can be saved by:
  - other requirements for RH,
  - change flow rates during night and weekends,
  - lowering amount of outside air,
  - changing between general en ultra clean conditions



Often used ventilation typologies in hospitals (West Europe)

Roomtype	Ventilation type	Filtration	Windows	Heating/cooling
Operating room	Mechanical	Good (HEPA)	Can't be opened	Usually sufficient
Isolation room	Mechanical	Good (ePM1 70%)		
Patient room ward	Mechanical	Good (ePM1 70%)	**Can be opened**	**Sometimes insufficient**
Sterilisation room	Mechanical	Excellent (HEPA)	Can't be opened	Usually sufficient
Laboratory	Mechanical	At least (ePM1 70%)	Can't be opened	Usually sufficient
Outpatient clinic	Mechanical	At least (ePM1 70%)	Can't be opened	**Sometimes insufficient**
Offices	Mechanical	Good (ePM1 70%)	**Can be opened**	**Sometimes insufficient**

What is needed to mitigate climate change conditions

For sufficient indoor AirQuality in hospitals and low energy consumption:

- Patient rooms and wards seem to be the most interesting and challenging
- Clear performance requirements for Indoor AirQuality, like SUP 1 according to EN 16798-3
  - Supply air with very low concentrations of particles
  - $PM_{2.5}$ annual mean ≤ 1.25 µg/m^3
  - PM_{10} annual mean ≤ 3.75 µg/m^3
  - Sound level < 30 dB(A)
  - No natural ventilation
  - Periodic check of ventilation performance
- Heat recovery shall be applied
- Outdoor sun protection shall be applied (overhang can also be used as equivalent)
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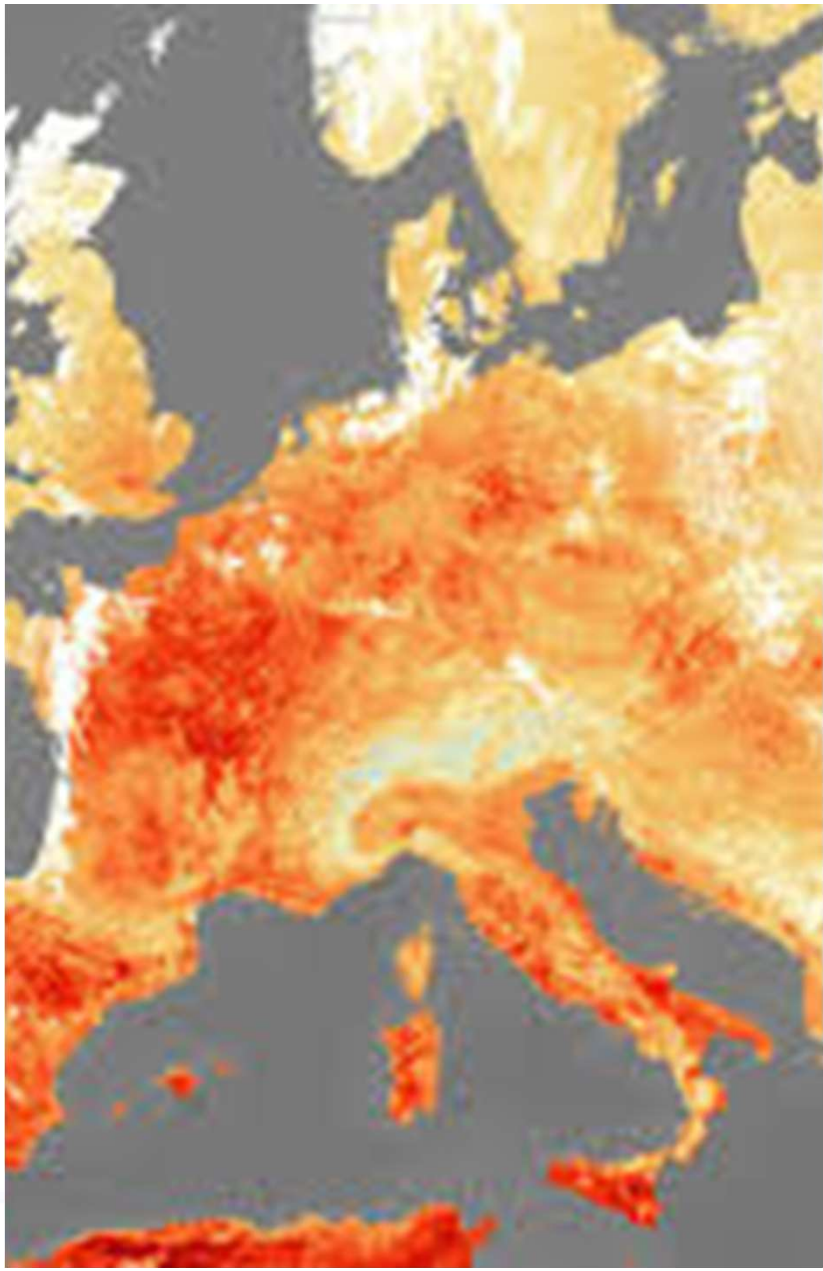

Conclusions

- Ventilation systems in hospitals are already good (mainly mechanical systems and at least ePM1 70%)
- Air supply directly from outside (unfiltered) may introduce a risk for patients, staff and visitors
- Cooling capacity may be to low if extreme temperatures occur

Discussion

Propositions:

- Ventilation systems in hospitals are sufficient to deal with climate change
- Indoor AirQuality in hospitals is sufficient
- Additional requirements for indoor AirQuality in terms of fine dust, etc. are not necessary
- It is up to the hospitals themselves to decide whether to take measures

Take home message

Define performance requirements for indoor AirQuality in patient rooms and wards (EN 16798-3, SUP 1)

Use outdoor sun protection and heat recovery systems


Thank you for your attention:
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