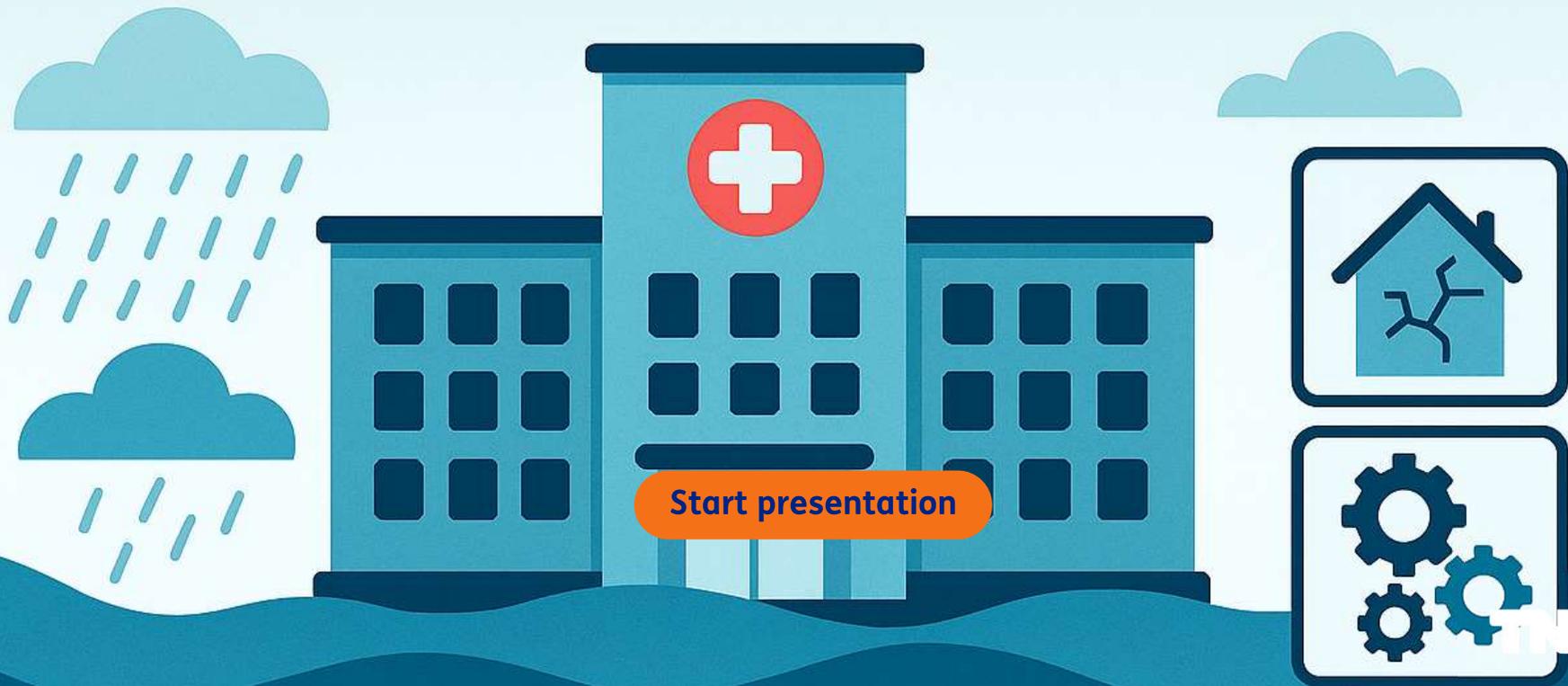


WATER ROBUSTNESS DUTCH HOSPITALS



Start presentation

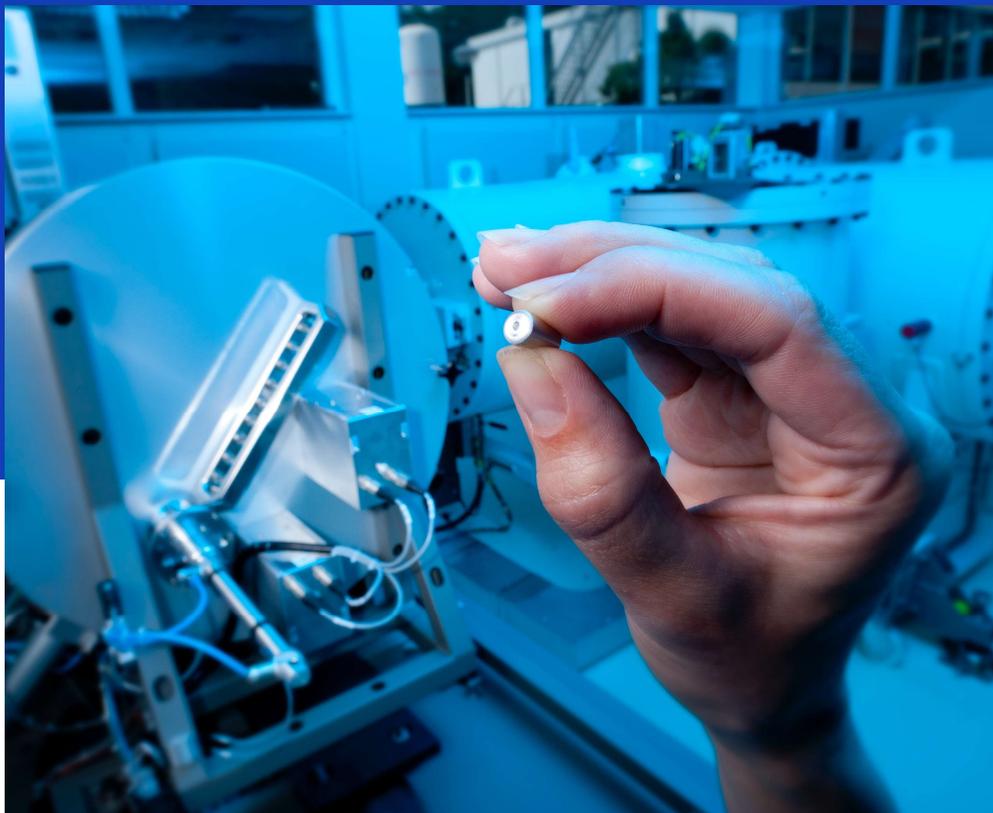
Disclosure

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. Introduction
2. Dutch situation
3. Discussion

Dia 3

Sv1 Dit komt niet duidelijk terug in de titels van sheet 4 t/m 13. Agenda s.v.p. op deze sheets aanpassen.

Heumen, S.P.M. (Stefan) van; 2025-08-25T15:08:05.212

RT1 0 Klopt maar zijn wel de aspecten die de revue passeren lijkt me. Het zijn maar een paar sheets. Volgens mij behandel ik al deze elementen?

Traversari, A.A.L. (Roberto); 2025-08-25T15:30:01.429

Sv1 1 OK

Heumen, S.P.M. (Stefan) van; 2025-08-26T07:22:16.698

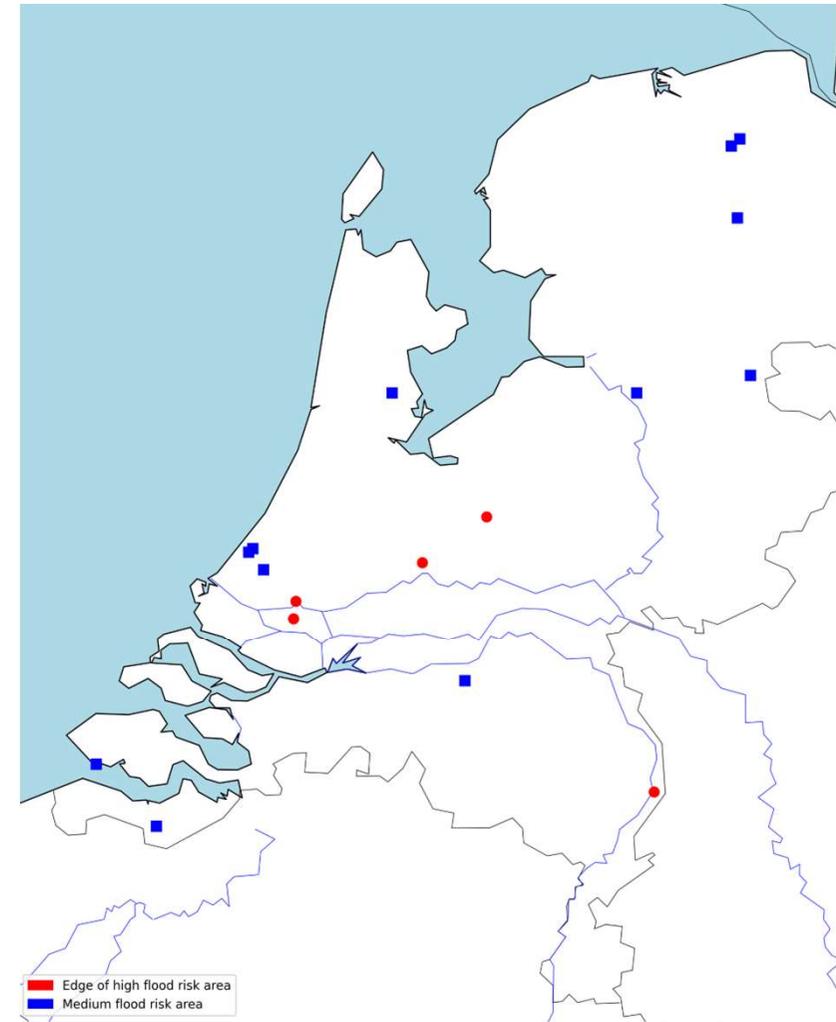
Climate change

- **More frequent extreme weather (rain)**
- **Risk of local flooding increases**
- What is the impact on hospitals, and how are they prepared?
- These are the questions facing the government
- In 2015, TNO already conducted research into this on behalf of the Health Care Inspectorate (TNO 2015 R11234)



Hospitals at risk for flooding

- No hospitals in area with high risk of flooding
- 5 hospitals on the edge of an area with a high risk of flooding
- 12 hospitals in an area with a medium risk of flooding
- 16 hospitals on the edge of an area with a medium risk of flooding
- So, approximately 50% of Dutch hospitals are at (some) risk of flooding



Is the risk for flooding fiction?

Wów, de #Boelelaan staat onder water...
Waar is 't waterballet dan? #VUmc



Approach

- **Literature study**
 - Guidelines
 - Case studies
- **Survey**
 - Alle Dutch Hospitals
- **Interviews**
 - Hospitals hit by flooding (n=3)

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Focus on critical departments

- Operating room
- Intensive care units
- Emergency department



Critical technical facilities based on literature

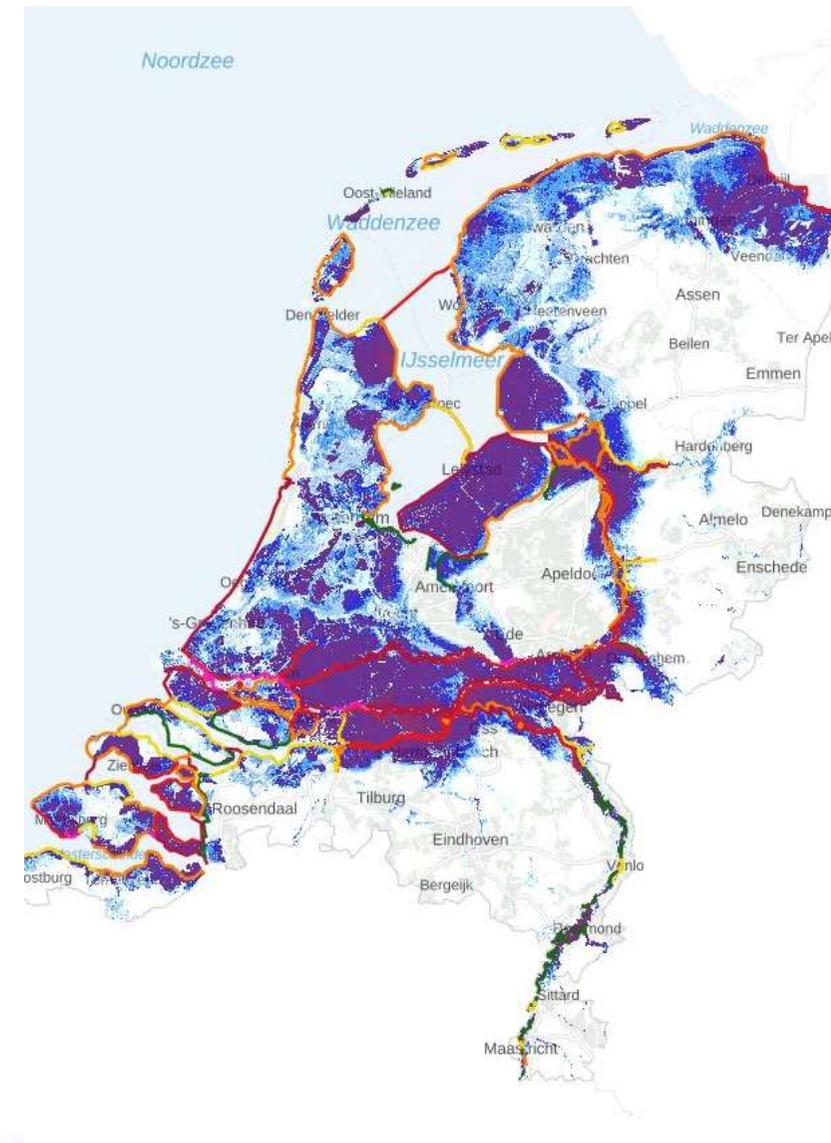
The following technical facilities are essential for the functioning of critical departments:

- Electricity (emergency power);
- HVAC systems (heating, cooling, ventilation, and air conditioning);
- Communication systems (ICT systems, telephony, data);
- Medical gas and drinking water supplies;
- Elevator systems;
- Sanitation (fresh water and sewer)
- Safety equipment.



Are Hospitals water-robust yet?

- No, most hospitals are not (yet) water-robust
- Location of vital hospital functions: emergency power and technology are often on the ground floor or in the basement; the ER is usually on the ground floor; ORs and ICU are often higher up in the building
- 17 Emergency locations are in medium-risk or bordering high-risk areas (with a maximum flooding water level of 0 to 3.5 m)
- Despite water-robust measures and available supplies, hospitals indicate that evacuation is initiated as quickly as possible in the event of a flood



Recommendations

Recommendations for construction plans/measures at all hospital locations

- Do not house vital functions and essential technical facilities underground (in a basement)
- Take measures to prevent flooding on the ground floor
- Do not create crawl spaces
- Prevent backflow into the sewer system
- Install a sufficiently robust rainwater drainage system
- Ensure adequate drainage, infiltration, and/or buffering of rainwater on the hospital grounds



Recent research

Report of TwynstraGudde 23 June 2025:

- Commissioned by VWS
- The research clearly shows a need among healthcare providers for knowledge and insights that help them assess the likelihood and impact of climate risks
- Making climate risks more tangible with validated data and models
- Setting up a Community of Practice
- Establish central direction to arrive at policy frameworks and standards

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Recent research

European LIFE RESYSTAL project:

- The LIFE RESYSTAL project develops, demonstrates, evaluates and disseminates a **framework for climate-resilient health systems** with seven pilot hospitals and two local and regional health systems.
- Deliverables e.g.:
 - Practical Guide for Building Climate-Resilient Health Systems (November 2024)
 - Procuring for Adaptation: Incorporating Climate Adaptation into Healthcare Investment Decisions (January 2025)
 - Guidelines for Greener Procurement in Hospitals (April 2024)

www.life-resystal.eu



Experience from casus

Evacuation:

- Vertical transport (elevators) not working, power outages and flooded elevator shafts
- Patients (340) must be carried out of the hospital via stairwells
- Not only the patients but also the files and medication had to be sent to other hospitals, a mega operation and a logistical nightmare

Technology:

- Many distribution and switch cabinets below ground level
- All switch cabinets had to be replaced
- All pumps, generators and critical infrastructure were below ground level and had to be replaced
- Costs approximately EUR 50.000.000,=



Conclusions

- There are no hospital locations with emergency care in an area with a high flood risk
- This says nothing about the risk of flooding during extreme local rainfall
- There is limited attention paid to measures that reduce bottlenecks caused by extreme precipitation
- There are no guidelines in the Netherlands for dealing with extreme precipitation; the safety regions are responsible for this



Discussion

Propositions:

- It is up to the hospitals themselves to decide whether to take measures
- A stress test should be conducted to determine whether hospitals have taken sufficient measures
- There should be system hospitals that can operate on an isolated basis for at least a certain period, not all hospitals are system hospitals



Take home message

Hospital evacuation is very complex due to the vertical transport of people who are unable to help themselves. This must be taken into account.

The more floors there are, the more complex it becomes.

Prevention is better than cure.



Theme name Place text here



**Thank you for your attention:
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