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Healthier built environment with comprehensive indoor hygiene concept

MERJA AHONEN, CHIEF RESEARCHER (INDOOR HYGIENE), PH.D.

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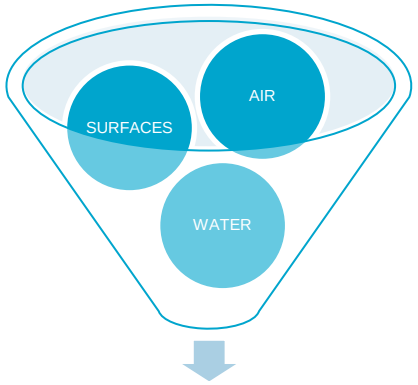

Indoor Hygiene Concept = Infection prevention with built environment

Research on **antimicrobial coatings**, indoor hygiene and the solutions of hygienic construction.

- Studying antimicrobial coated products in real life settings (e.g. hospital, kindergarten, elderly care)
- Developing comprehensive indoor hygiene (IH) concept (surfaces, water, air) and participating in commercialization processes of IH products
- Participating in standardization work, like ISO TC330 - Surfaces with biocidal and antimicrobial properties
- Studying biofilm management using nanobubbles

- Research and expert services related to **water**, **materials in contact with water** and **indoor environment hygiene** – locally, nationally and internationally.
- Co-operation with ca. 250 organizations like ministries, national and international companies, universities and research institutes

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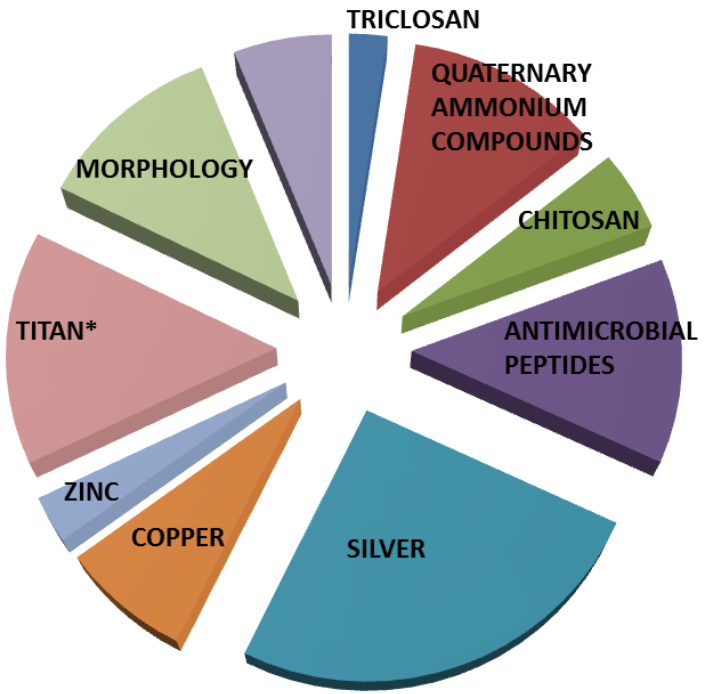
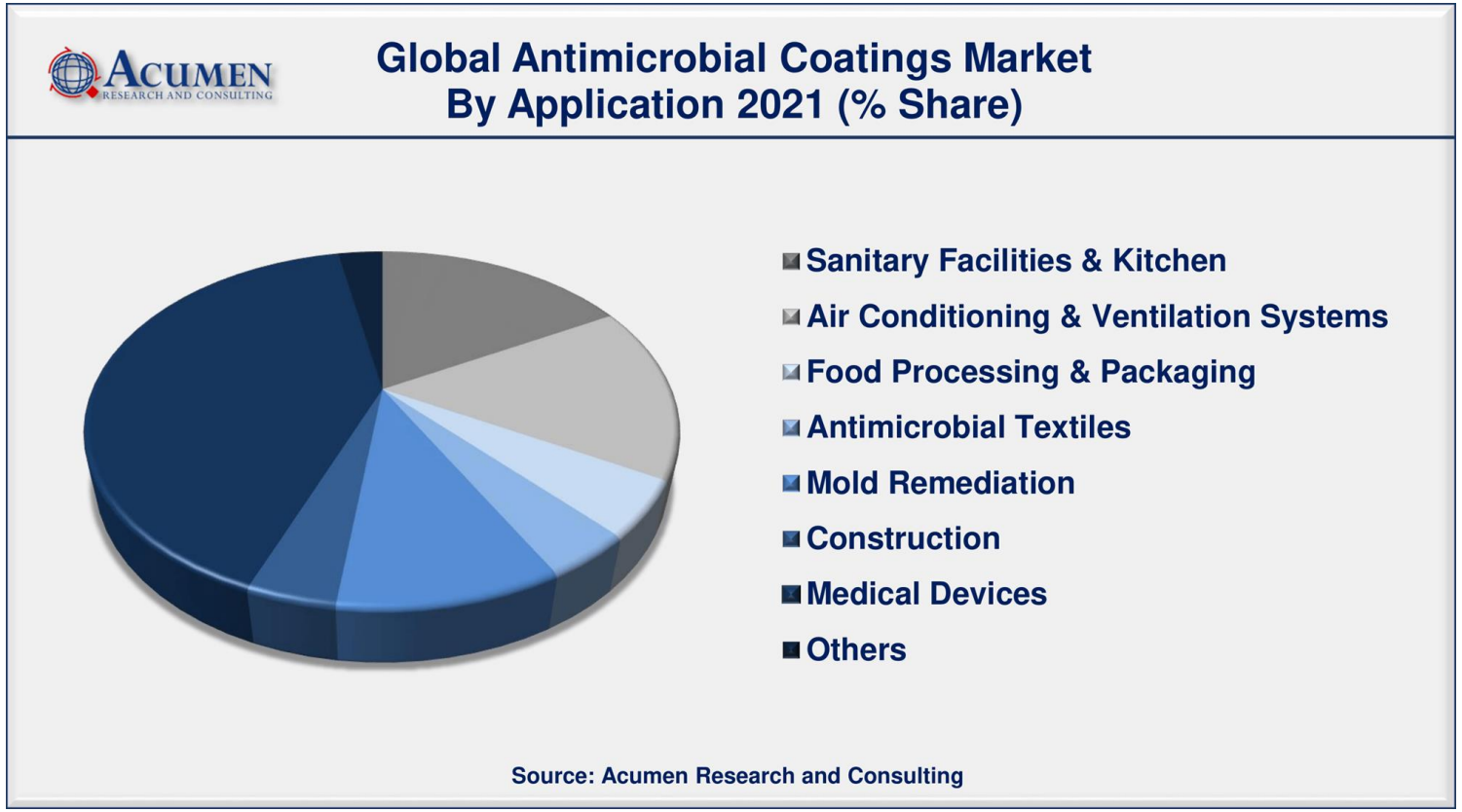
Antimicrobial coatings inhibit the ability of microorganisms to grow on the surface



The most studied antimicrobial materials. Web of Science: >3000 articles, search ”antimicrobial surfaces“ or ”antibacterial surfaces“ (05/2020)



Indoor hygiene research continuum

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Turun yliopisto
University of Turku

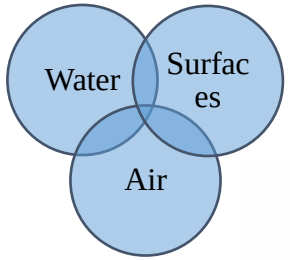
Living Lab research

Tekes

HYGTECH 1
4/2012-10/2014

Satakunta region (hospital ward, daycare center, office, school, sheltered housing)

Business concept creation



Tekes

HYGTECH 2
8/2013-10/2014

Co-creation of the concept based on research results, collaboration or researchers, companies and Living Lab representatives.

Commercialization and ”making the market”

HygTech Alliance
Active design, made to share.

SATAKUNTALIITTO

HygLi 1/2015-12/2017

Hygiene indoors RT-guidelines in collaboration with the Building Information Foundation RTS sr.

Opening indoor hygiene SME’s exports to Middle East construction markets

IHMEC
Breaking the Infection Chain

Interreg
Central Baltic

SIHI
9/2018–4/2019
Regional innovation experiment

IHMEC 3/2018 – 5/2021

Connecting professionals in planning, designing, building and furnishing in Finland, Sweden and Estonia.
Exporting IH solutions to Middle East.

EU COST AMiCI 04/2016 - 04/2020 (SAMK)

CIG-15114: ePlatform for a “test bed” tool across EU for antimicrobial coating solutions in healthcare. 5/2020-10/2021. **(SAMK)**

Indoor hygiene research continuum

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Healthy water-transport vessels

SATAKUNTALIITTO

TERVA
3/2021-8/2023

Healthier life with comprehensive indoor hygiene concept

OPETUS- JA KULTTUURIMINISTERIÖ
UNDERVISNINGS- OCH KULTURMINISTERIET

HEAL
1/2022-12/2024

Management of water system biofilms using technology based on hydrodynamic cavitation

Elinkeino-, liikenne- ja ympäristökeskus

Nanobubble
3/2021-8/2023

Surface Transfer of Pathogens

HORIZON EUROPE

STOP
9/2022-8/2026

Regional Development Project, aims to introduce indoor hygiene into the shipbuilding sector.

Developing an overall concept of indoor hygiene that reduces the morbidity of people with infectious diseases.

Biofilm management through nanobubbles added to water. Replace traditional disinfecting chemicals.

New antimicrobial coatings to prevent spread of infectious diseases, 15 partners 9 countries, universities, research institutes, companies.

More about projects https://www.wander.fi/en/projects/

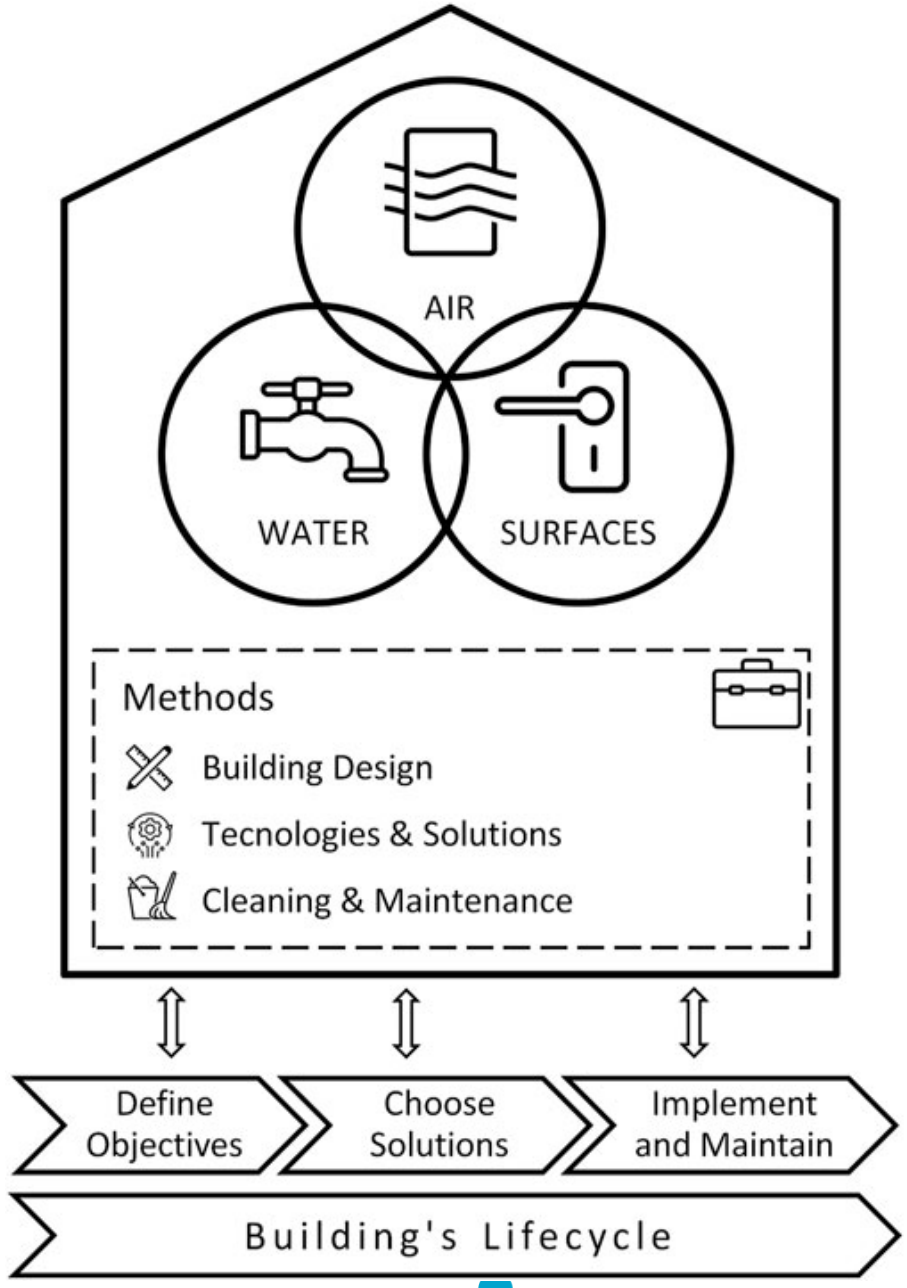
The indoor hygiene concept

All the elements of the indoor environment - **surfaces, air, and water system** - considered, different routes of infection transmission.

> appropriate infection prevention methods targeted at all these elements.

Focus on **a building's lifecycle**, starting from defining the hygiene objectives at an early stage, continuing to choose suitable solutions, and then implementing and maintaining them.

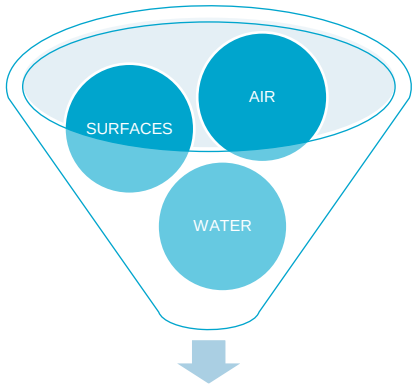
> A building's lifecycle starts from the needs assessment and design stages and continues to construction, commissioning, and use.
>
> The points of transition between the phases of a construction project are critical for maintaining the targets of the IHC



The image is adapted from Salonen et al. (2023) under a Creative Common Attribution. Methods for infection prevention in the built environment - a mini-review https://doi.org/10.3389/fbuil.2023.1212920

HEAL project - Healthier life with comprehensive indoor hygiene concept

- The HEAL project further develops the comprehensive indoor hygiene concept which combines the effects of **air, surfaces, and water**.
- The research provides knowledge and evidence on how the comprehensive indoor hygiene concept decreases the incidence of **infectious diseases** and thus sick days.
- Living Lab pilot sites in a day-care center and an elderly care home
- Funding from Ministry of Education and Culture, duration January 2022 to December 2024
- Further details https://www.wander.fi/en/projects/heal/



Indoor Hygiene Concept = Infection prevention with built environment

HEAL – Study setup, elderly care

- 8 units of elderly care (two buildings and two managers), located in Pori city
  - a form of living in the last phase of life
- 14 elderly people living in one unit, 112 people in total (+ staff)
- 4 units as an intervention group (IHC techologies installed - surfaces, air, water)
  - 56 elderly people + staff
  - 2 units in each building and under each manager
- 4 units as a reference group
  - 56 elderly people + staff
  - 2 units in each building and under each manager
- Comparison of the efficacy of intervention vs. no intervention (traditional practices)
  - Microbial counts, infectious diseases, cost-effectiveness

HEAL – Indoor hygiene technologies

- Surfaces
  - TiO_2 nanocoating, activated by normal lighting, spray
  - Ag based coating on table tops and door handles (coating an integral part of the product)
  - Touchfree taps
- Air
  - Mobile air cleaner
- Water
  - Automated flushing & temperature control

- All products available on the market

Collecting data for analysis

- Microbial (bacterial) sampling: surfaces, air, water
  - Surface samples - swapping, culturing, counting
    - Very early morning, before cleaning and before patients wake up
    - Total bacterial count and indicators: *E. coli*, total coliforms, *S. aureus*, enterococci
  - Plan to start genome based studies (species) in collaboration with University of Tartu, Estonia
- Air quality: continuous monitoring and microbial sampling
- Water quality: microbial sampling
- Morbidity to infectious diseases (respiratory and gastrointestinal infections)
  - Patients and staff
  - Nurses collect data on patients, anonymously: sick days, age distribution, cannula or not, walking or bed patient
  - Use of hand sanitiser is monitored

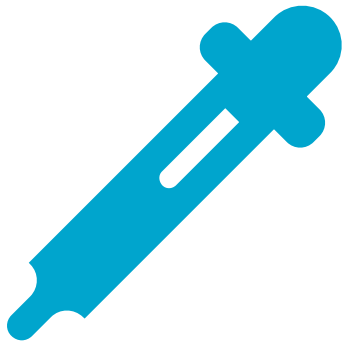
Results

- Living Lab research setup built ready
  - Discussions with property owners, building users and IHC technology suppliers take weeks to months to get everything planned and agreed, and it will take weeks/months more to build the Living Lab.
  - Ethical approval, agreements, etc
- Data collection started 3/2023, follow-up until 11/2024
  - Microbial sampling
  - Morbidity to infectious diseases (respiratory and gastrointestinal infections)
  - Air quality monitoring
- Statistical analysis of the data 3-11/2024, first results available for publication in the end of 2024
- Evaluation of cost-effectiveness 12/2024

WANDER's scientific publications on indoor hygiene and antimicrobial coatings

- Salonen N, Ahonen M, Sirén K, Mäkinen R, Anttila V-J, Kivisaari M, Salonen K, Pelto-Huikko A, Latva M (**2023**) Methods for infection prevention in the built environment - a mini-review. Front. Built Environ. https://doi.org/10.3389/fbuil.2023.1212920
- Mäki A, Salonen N, Kivisaari M, Ahonen M, Latva M (**2023**) Microbiota shaping and bioburden monitoring of indoor antimicrobial surfaces. Front. Built Environ. 9:1063804. https://doi.org/10.3389/fbuil.2023.1063804
- Blomberg E, Herting G, Rajarao GR, Mehtiö T, Uusinoka M, Ahonen M, Mäkinen R, Mäkitalo T & Odnevall I (**2022**) Weathering and antimicrobial properties of laminate and powder coatings containing silver phosphate glass used as high touch surfaces. Sustainability 14(12), 7102. https://doi.org/10.3390/su14127102
- Ivask A, Ahonen M, Kogermann K (**2022**). Antimicrobial Nano Coatings. Nanomaterials, 12, 4338. https://doi.org/10.3390/nano12234338
- Salonen N, Mäkinen R, Ahonen M, Mäkitalo T, Pelto-Huikko A, Latva M (**2022**) A comprehensive indoor hygiene concept for infection prevention and control within built environments. Front. Built Environ. 8:1075009. https://doi.org/10.3389/fbuil.2022.1075009
- Pietsch F, O'Neill AJ, Ivask A, Jenssen H, Inkinen J, Kahru A, Ahonen M, Schreiber F (**2020**) Selection of resistance by antimicrobial coatings in the healthcare setting. Journal of Hospital Infection. Vol 106 (1): 115-125. https://doi.org/10.1016/j.jhin.2020.06.006
- Dunne CP, Askew PD, Papadopoulos T, Gouveia IC, Ahonen M, Modic M, Azevedo NF, Schulte S, Cosemans P, Kahru A, Murzyn K, Keevil CW, Riool M & Keinänen-Toivola MM (**2020**). Anti-Microbial Coating Innovations to prevent infectious disease: a consensus view from the AMiCl COST Action. Journal of Hospital Infection, Vol 105 (2), pp 116-118. https://doi.org/10.1016/j.jhin.2020.04.006
- Rosenberg M, Ilić K, Juganson K, Ivask A, Ahonen M, Vinković Vrček I, Kahru A (**2019**) Potential ecotoxicological effects of antimicrobial surface coatings: a literature survey backed up by analysis of market reports. PeerJ 7:e6315. https://doi.org/10.7717/peerj.6315
- Adlhart C, Verran J, Azevedo NF, Olmez H, Keinänen-Toivola MM, Gouveia I, Melo LF, Crijns F (**2018**) Surface modifications for antimicrobial effects in the healthcare setting: a critical overview. J Hosp Infect; 99: 239-249. https://doi.org/10.1016/j.jhin.2018.01.018
- Dunne SS, Ahonen M, Modic M, Crijns FRL, Keinänen-Toivola MM, Meinke R, Keevil CW, Gray J, O'Connell NH, Dunne CP (**2018**) Specialised cleaning associated with antimicrobial coatings for reduction of hospital acquired infection. Opinion of the COST Action Network AMiCI (CA15114). Journal of Hospital Infections 99(3):250-255. https://doi.org/10.1016/j.jhin.2018.03.006
- Ahonen M, Kahru A, Ivask A, Kasemets K, Kõljalg S, Mantecca P, Vinković Vrček I, Keinänen-Toivola MM, Crijns F (**2017**) Proactive approach for safe use of antimicrobial coatings in healthcare settings: opinion of the COST Action network AMiCI. Int J Environ Res Public Health. 14(4). http://dx.doi.org/10.3390/ijerph14040366.
- Inkinen J, Mäkinen R, Keinänen-Toivola MM, Nordström K, Ahonen M (**2017**) Copper as an antibacterial material in different facilities. Letters in Applied Microbiology, 64(1): 19-26. https://doi.org/10.1111/lam.12680.
- Mäkinen, R., Miettinen, I.T., Pitkänen, T., Kusnetsov, J., Pursiainen, A., Kovanen, S., Riihinen, K. & Keinänen-Toivola M.M. (**2013**). Manual faucets induce more biofilms than electronic faucets. Canadian Journal of Microbiology, 59(6), 407-412. https://www.ncbi.nlm.nih.gov/pubmed/23750955

Workshop questions



Indicators of infection control practices. What else could be monitored, in addition to hand sanitizer use, to ensure that units are as similar as possible?

Cost-effectiveness. Is there a convenient calculation model to demonstrate cost-effectiveness?

Thank you for your interest!

Merja Ahonen
Chief researcher (indoor hygiene), PhD
merja.ahonen@samk.fi

https://www.wander.fi/en/

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