THE NEW ARCHITECTURE PARADIGM IS HEALTH

International Union of Architects (UIA)

WORLD ARCHITECTURE DAY 2022

3 October 2022

Dr Jako Nice

uia

Tshwane University of Technology
We empower people

TUT ARCH + ID

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65.3

* Life expectancy

* Indoors

70

* at home

30

* sleeping (bedroom)

8

* outside

2020 - current 50% of the 7.3 Billion people globally reside in urban environments

2050 - estimate 68% (5 billion)

2060 - (over the next 40 years) Africa 300% 395 million - 1.3 billion

https://www.un.org

https://www.researchgate.net/publication/320543227

BUILDING FOR HEALTH MATTERS

BUILDING DESIGN MATTERS

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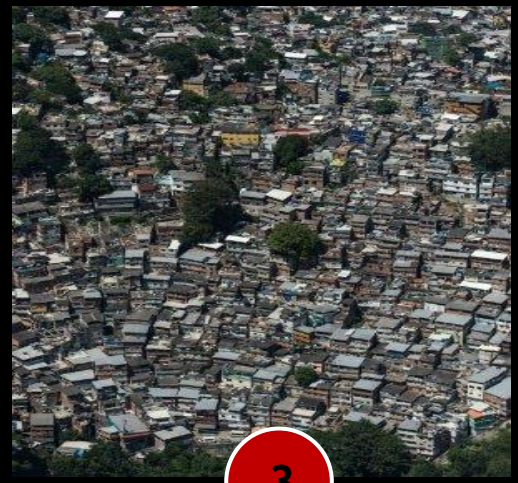
1

South Africa

2

India



3

Brazil

Reference: Images: 1_DHS South Africa, 2_ Rafiq Maqbool/Associated Press & Christian Als/Panos, 3_Cities Alliance & News 24

HEALTH

THE DATA

SOUTH AFRICA 2022 – 60.55 MILLION POPULATION

DEVELOPED WORLD COUNTRIES ESTIMATE HAI RATES: 9.8 PER 100 PEOPLE
DEVELOPING WORLD COUNTRIES ESTIMATED HAI RATES: 15.5 PER 100 PEOPLE
(Durlach et al. 2012; Alvarez-Moreno et al. 2014 and Brink et al. 2006)

LOCAL HEALTH IMPACT SOUTH AFRICA_TB/HIV/COVID19

2021 - COVID19 : (4.02 Mill cases, 102 000 deaths)

2019 – TB INCIDENCE RSA average	**615 / 100 000**
2017 – TB INCIDENCE (in high incidence areas)	**1165 / 100 000**
2019 – TB MORTALITY	**58000 (62% HIV Co-infection)**
2018 - HIV AIDS INFECTION	7.7 Million
2017 – AIDS MORTALITY	71 000

(CDC 2020, SAMJ 2019, WHO, NIOH)

PRACTICAL APPROACHES

DO YOU CONSIDER IPC

Appreciate the variety and persistence of microorganisms

- **The spread of infectious bacteria, fungi, viruses and single cell organisms** *(prokaryotic & eukaryotic)* **specifically in hospitals are widely known to be first by human contamination** (Hospodsky et al. 2012)

- **Secondly dependent on environmental conditions** (Basu. et al. 2007).

- **This is exacerbated when microbial favourable environmental conditions are provided** (Wolfaardt. et al. 2018).

Emerging and re-emerging diseases

BUILDINGS ARE NOT ISOLATED ARTIFACTS; THEY FORM PART OF A LARGER SYSTEM: AN URBAN ECOSYSTEM.

HOW THE ECOSYTEM RESPONDS IS DEPENDANT ON THE SERVICES IT PROVIDES AND RECEIVES, AND THE SOCIAL DRIVERS OF THE SYSTEM.

INFECTION PRINCIPLES

METHODS OF INFECTION - THE HIDDEN BE FACTORS

PROBABILITY OF INFECTION - simplified

$$P_{inf} = \frac{new\ cases}{susceptibles} = 1 - e^{\frac{-Iqpt}{Q_{oa}}}$$

I_p = (D x S x T x V) / H_δ

D) **Dose** S) **Site of contact** T) **Time of contact** V) **Receptive host site** H) **Force of combined immunity**

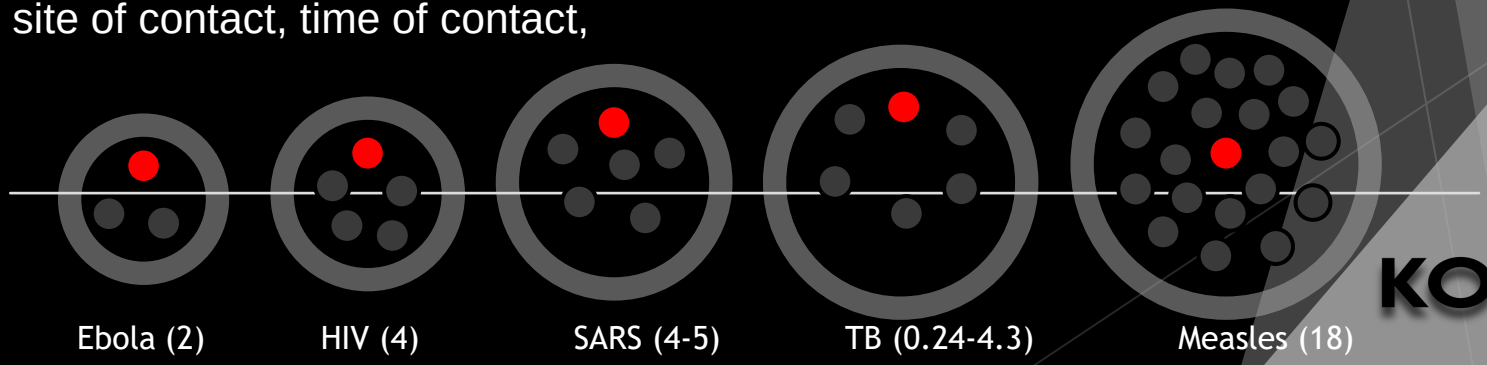
Receptive host, site of contact, time of contact, infectious dose)

BASIC REPRODUCTIVE NUMBER (R_0)

For each sick person how many subsequent new people will be infected – the contagiousness of an infectious disease

R_0 Factors: receptive host, site of contact, time of contact, dose)

- Infectious period
- Contact rate
- Mode of Transmission



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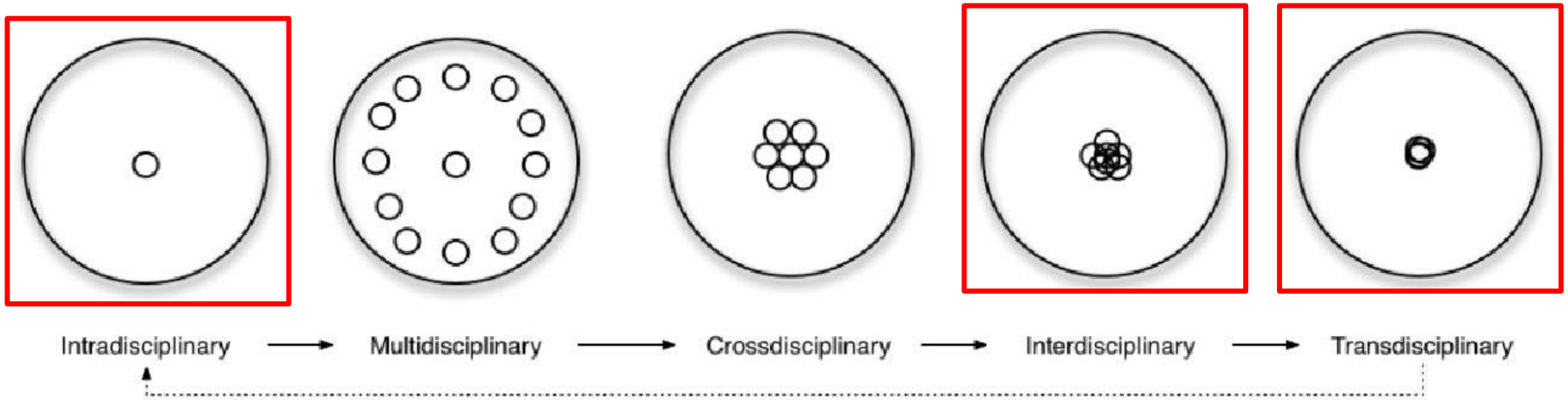
We have come a long way, but we have yet some distance to go.
Moving from intra - to inter - to Transdisciplinary architecture

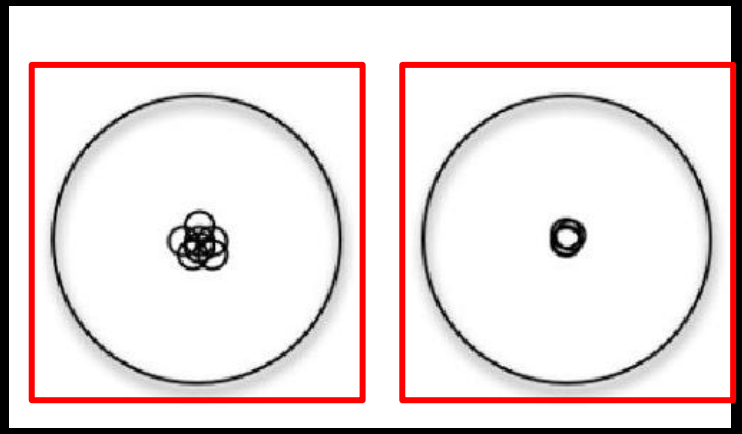


Alexander Refsum Jensenius

Architecture is the will of an epoch translated into space.

Mies van de Rohe

Architecture
Engineering
Microbiology
Biology
Anthropology
Medical
Human Sciences



Interdisciplinary Transdisciplinary

Alexander Refsum Jensenius

Shared factors and common variables
Functional outcomes and interdependencies

IUSS HEALTHCARE GUIDELINES SOUTH AFRICA 2014_

CASE STUDY (1)

Council for Scientific and Industrial Research (CSIR) & National Department of Health South Africa

- Policy and Service Context
- Strategic planning
- Site selection
- Briefing the implementing agent or consultant team

Gazette No

37348: R116, 17 February 2014
37790: R512, 30 June 2014
38776: R4141, 8 May 2015

- PLANNING AND DESIGN
- Public sector
- Private sector guidance

- First, do no harm
  - Healing environment for users
  - Occupational well-being and motivation for staff
  - Accessibility and inclusive design
  - Emergency preparedness and resilience

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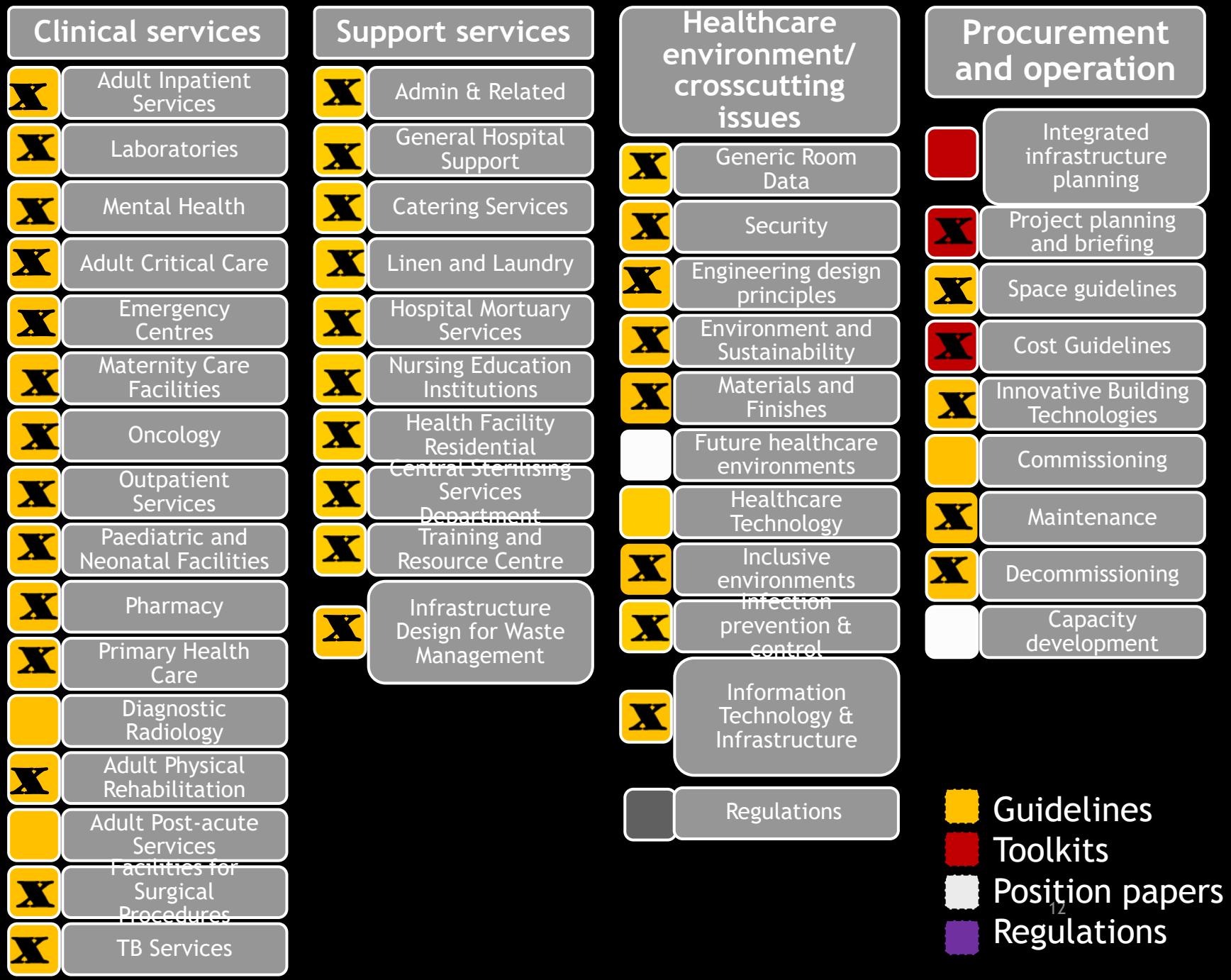
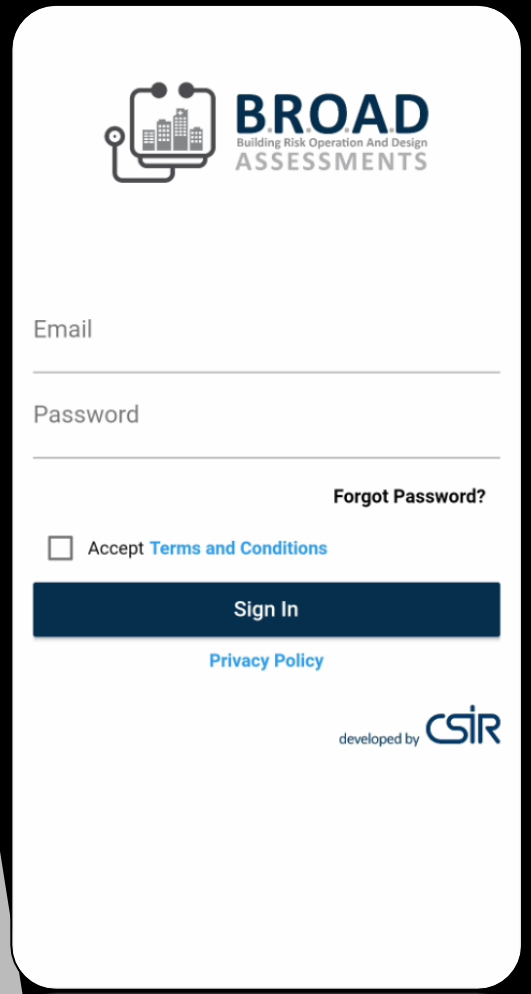
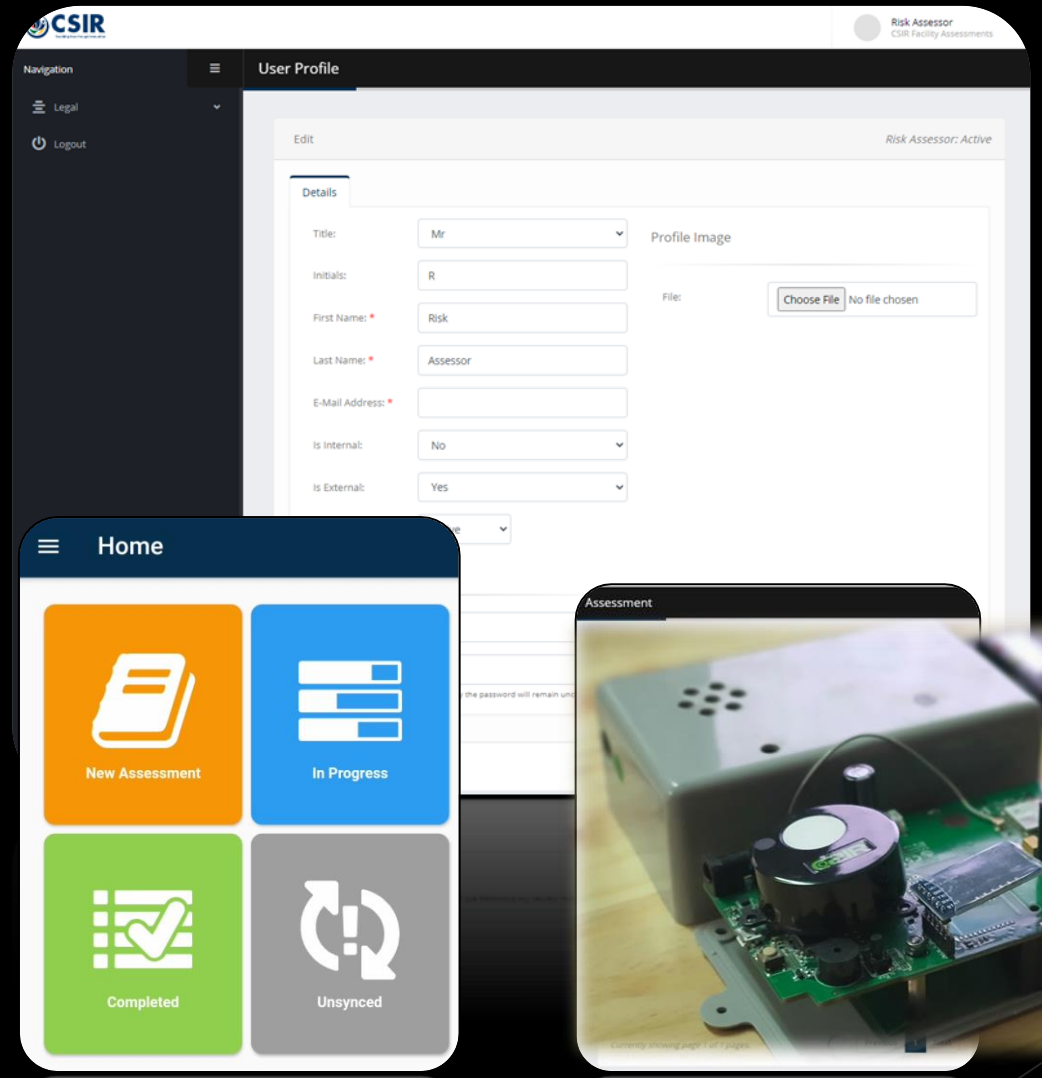

Clinical services
Adult Inpatient Services
Laboratories
Mental Health
Adult Critical Care
Emergency Centres
Maternity Care Facilities
Oncology
Outpatient Services
Paediatric and Neonatal Facilities
Pharmacy
Primary Health Care
Diagnostic Radiology
Adult Physical Rehabilitation
Adult Post-acute Services
Facilities for Surgical Procedures
TB Services
Support services
Admin & Related
General Hospital Support
Catering Services
Linen and Laundry
Hospital Mortuary Services
Nursing Education Institutions
Health Facility Residential
Central Sterilising Services Department
Training and Resource Centre
Infrastructure Design for Waste Management
Healthcare environment/ crosscutting issues
Generic Room Data
Security
Engineering design principles
Environment and Sustainability
Materials and Finishes
Future healthcare environments
Healthcare Technology
Inclusive environments
Infection prevention & control
Information Technology & Infrastructure
Regulations
Procurement and operation
Integrated infrastructure planning
Project planning and briefing
Space guidelines
Cost Guidelines
Innovative Building Technologies
Commissioning
Maintenance
Decommissioning
Capacity development
Guidelines
Toolkits
Position papers
Regulations

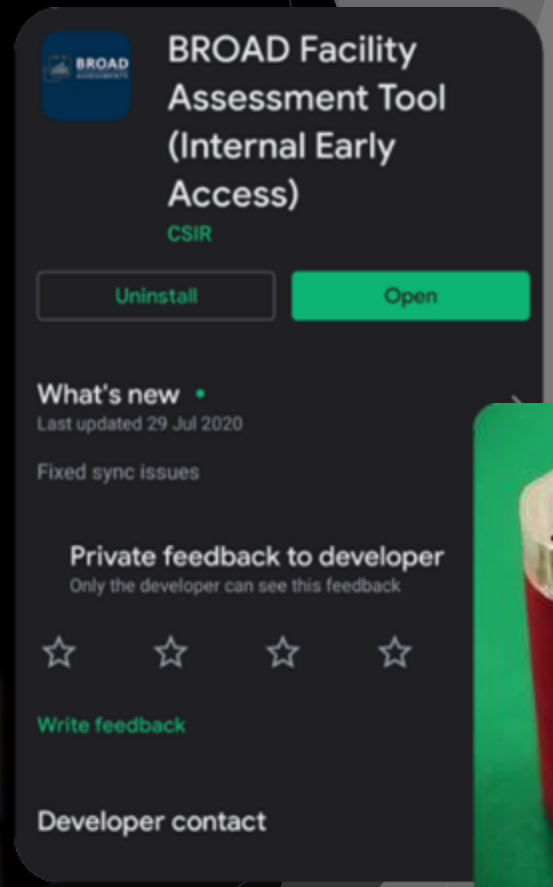
BROAD RISK ASSESSMENT TOOLS 2015-2022

CASE STUDY (2)

Council for Scientific and Industrial Research (CSIR)





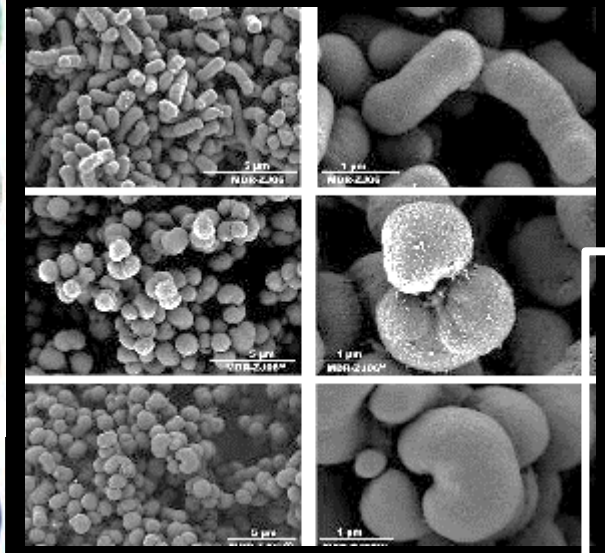


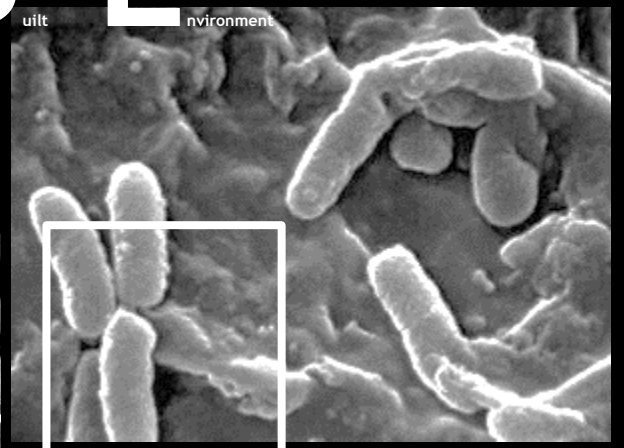
MoBE

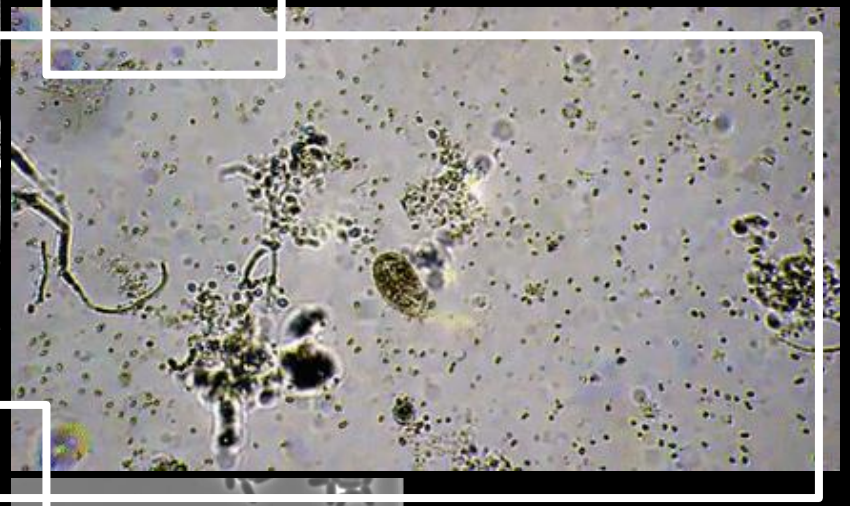
icrobiology f the uilt nvironment

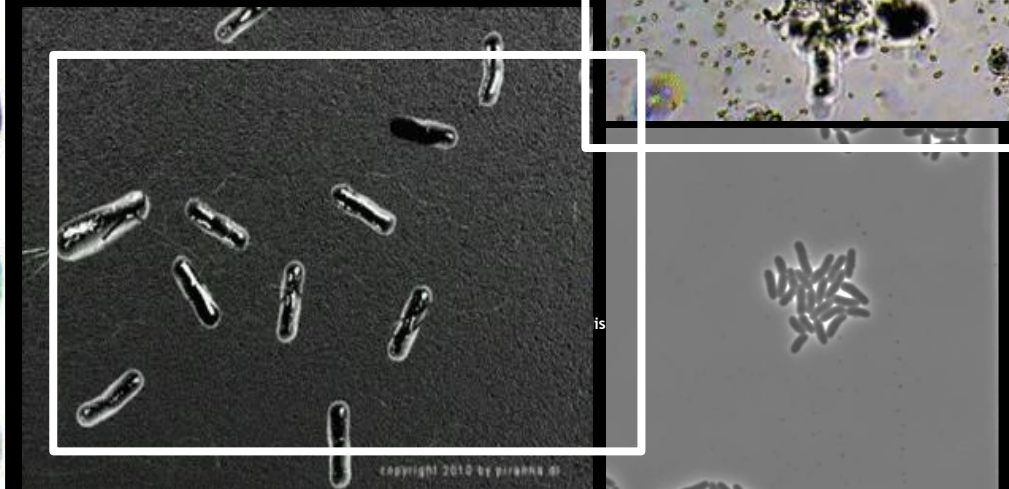
MICROBIOLOGY OF THE BUILT ENVIRONMENT

CASE STUDY (3)









MICROBIOME

Refers to the entire habitat, including the microorganisms (bacteria, archaea, lower and higher eukaryotes, and viruses), their genomes (i.e. genes), and the surrounding environmental conditions. The microbiome is characterised by the application of one or a combination of metagenomics, metatranscriptomics, and metaproteomics, together with clinical or environmental metadata. (Marchesi & Ravel 2015)

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The turning Torso - Calatrva (Seden) https://www.archute.com/the-turning-torso/

Adapted from,
Richard Corsi_PhD

http//.www.endoszkop.com wp-contentuploads201404the-human-body-and-bones.jpg

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MICROBIOLOGY OF THE BUILT ENVIRONMENT MOBE

"Building programs: Hospitals are often considered to be driven by strong programs, but have the tendency to shift between weak and strong." *(Sailer et al, 2013)*

For example, Offices have weaker programs. (most probably easier to manage IPC)

- Weak = Space configuration dependant vs
- Strong = Rules and policy enforced on the space

Building program and design reveals a new layer of infection prevention and control (IPC) complexity in the built environment form. a Stronger programme will in fact present a more temporal and dynamic microbial community, which is not only determined by the physical spaces but also by the movement and activity between them.

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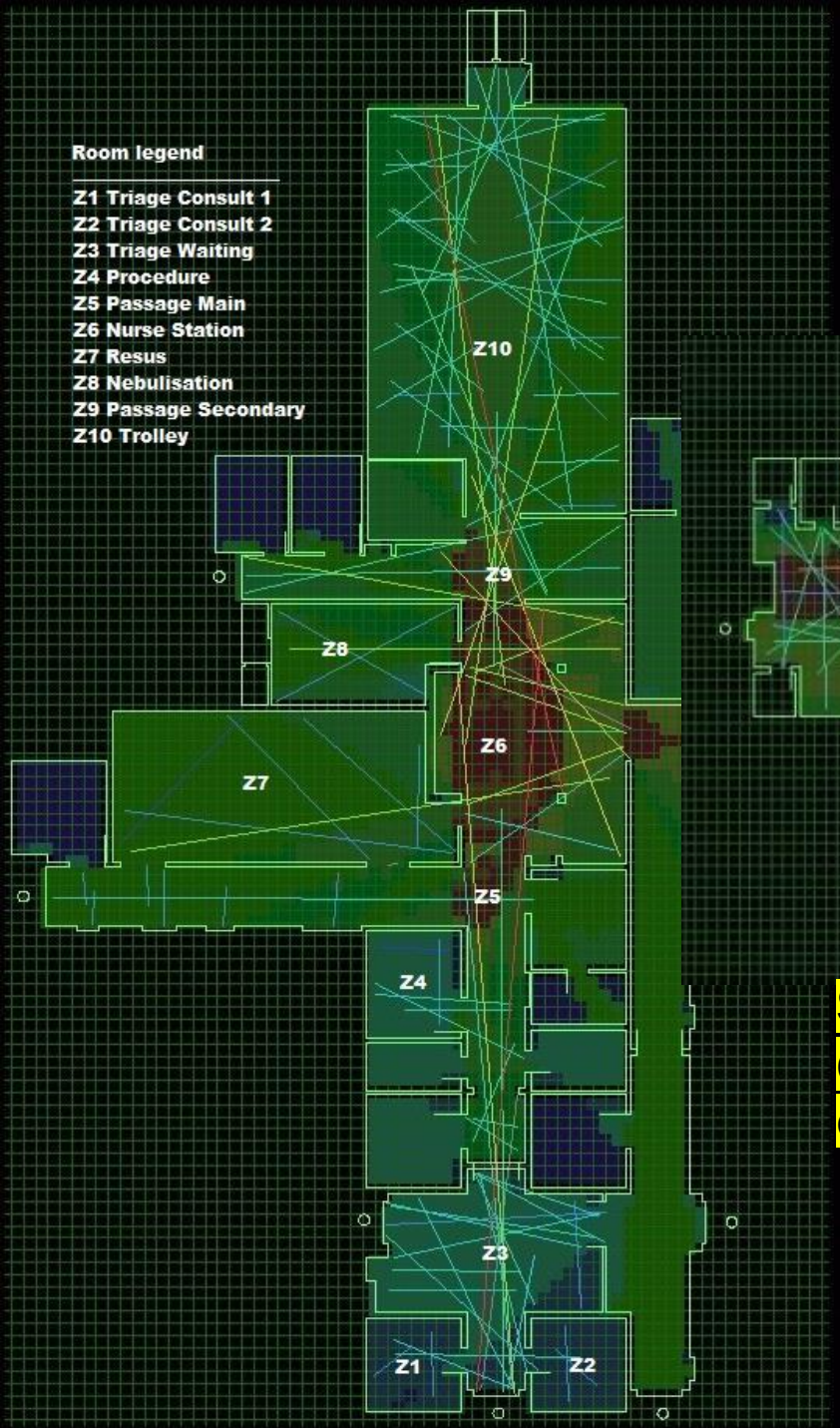

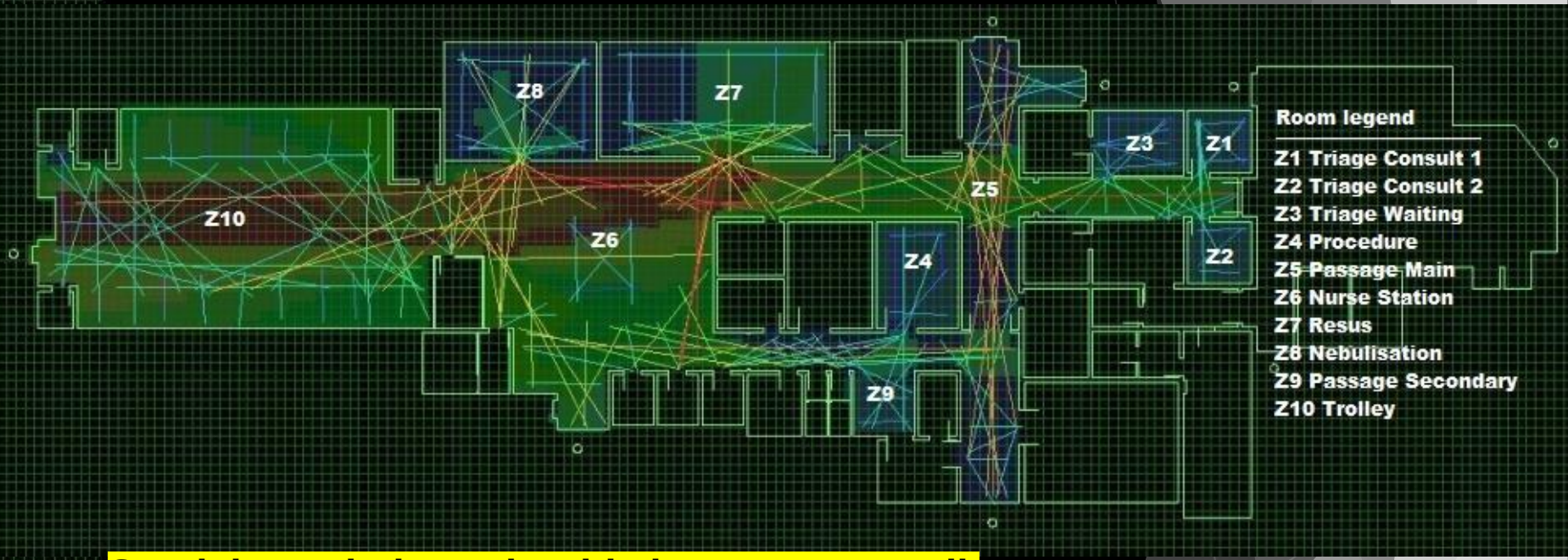

Spatial analytics should be core to all design processes, to understand the impact of planning and design decisions

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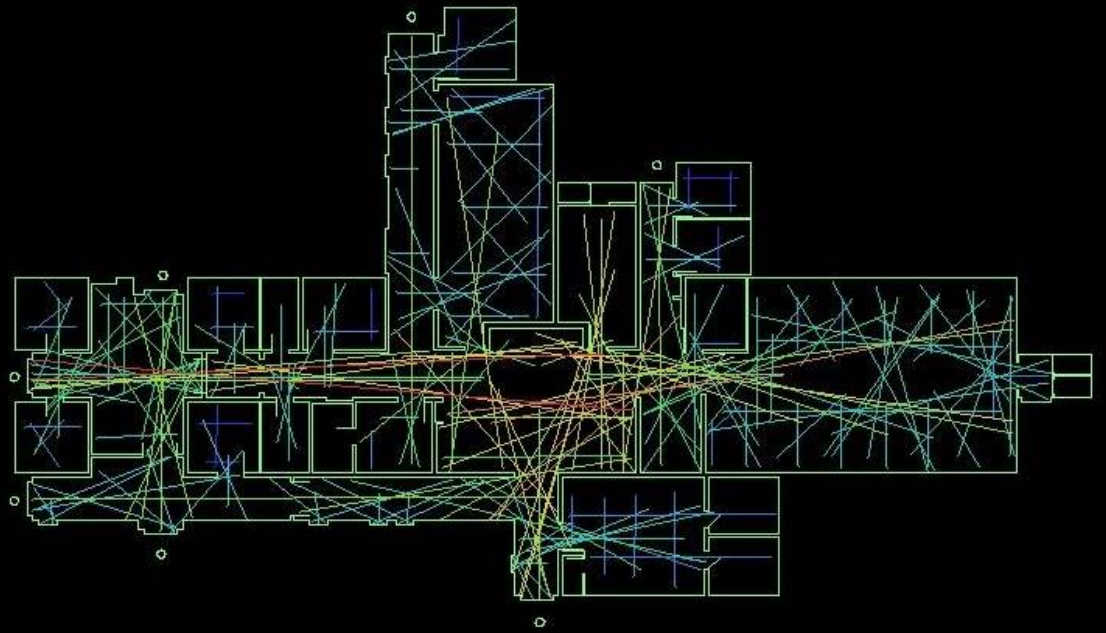
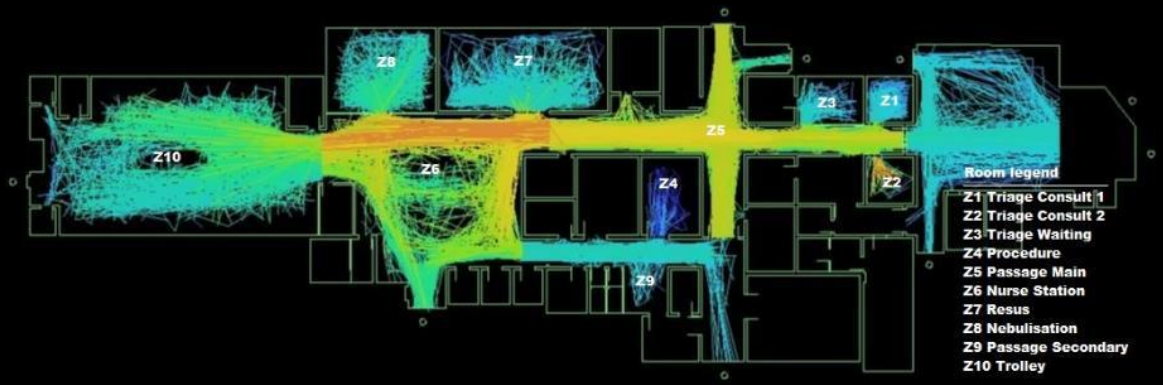
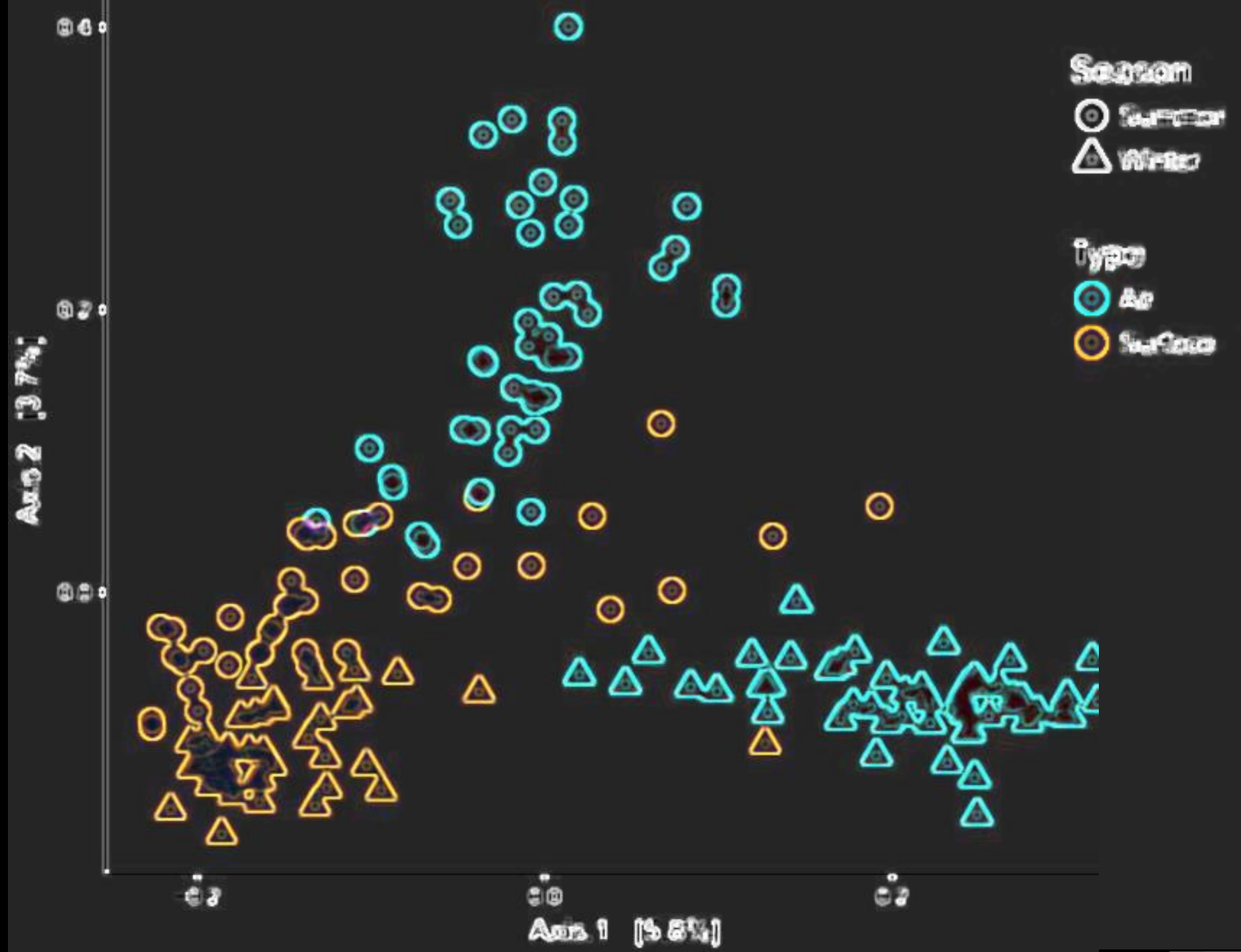


Winter

Summer




Season
Summer
Winter
Type
Air
Surface
Axis 2 [3.7%]
Axis 1 [5.6%]

MoBE CASE STUDY

THE SOUTH AFRICAN HOSPITAL MICROBIOME

Behavioural choices… cleaning frequency, procedure, animals, crowding etc. We find a correlation with the change in flow patterns, occupancy and the quanta of prevalent organisms. (in the number of Operational Taxonomic Units (OTU)

Ventilation is a sources drivers for distribution.***

The ventilation method accounts for a greater variance in airborne bacterial pathogenicity than ventilation rates alone.***

Layering infection prevention and control (IPC) policies and protocols onto a building system in effect makes the program stronger than the configuration

Key factors the influence built environment microbiome: Season, Geography, Ventilation, People/occupancy, Building material
Greater core integration in winter, from the microbial sampling indicated an increase in the number of Operational Taxonomic Units (OTU), i.e. a larger number of identified microorganisms compared to other rooms for both buildings

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a review of applied spatial metrics for application in healthy building design

- A number of studies investigated the microbiome of the built environment but with far less rigour with regards to built environment factors than the 4 studies mentioned.
- The omission of built environment factors studied in conjunction with microbiological characterisation studies results in underreporting of potential factors that influence the microbial community and limits the characterisation of the microbiome of building indoors.
- With only 4 of the - in excesses of 50 journal articles reviewed.
- Researchers recognised that building occupants directly, and, by extension, the architectural design (through factors of building design, planning, occupancy and use patterns) impacts on the microbial diversity and community composition of the building microbiome.

As published and presented at Indoor Air 2020

Healthy Buildings, Healthy Cities Lab

HBHC Lab

A collaboration between the Council for Scientific and Industrial Research (CSIR) and the SARChI Chair in Spatial Transformation (Positive Change in the Built Environment), Tshwane University of Technology (TUT)

SYMPOSIUM COORDINATORS

- Dr Jako Nice (CSIR), jnice@csir.co.za
- Prof Amira Osman (SARChI Chair In Spatial Transformation – TUT), OsmanAOS@tut.ac.za

The inaugural symposium on Healthy Buildings and Healthy Cities for South Africa, hosted virtually South African Standard Time (SAST).

Healthy Buildings, Healthy Cities '21

South Africa, Virtual Symposium

The impact of buildings on human health is profound, and has a direct cost impact on performance and output for its users. Infection and risk from contamination due to building design can be prevented. Healthy Building planning address design thinking on the current COVID-19, but also related disease burdens in South Africa and globally. Integrating health-related concepts into the traditional architectural tertiary education, building landscape and city making is core to changing the paradigm and skill the current and next generation of architects will require.

The HB&HCLab initiative through the Healthy Buildings, Healthy Cities '21 symposium aims to stimulate new thinking and build research and development initiatives to drive healthy building design and construction. COVID-19 and related health care associated infections (HAI), nosocomial disease burdens (TB etc.) and the contamination role of the built environment in Southern Africa and globally positions this work as critical. With the global COVID-19 pandemic, much has been debated about urbanisation, cities and density; this symposium on diverse health related themes aims to stimulate transdisciplinary thinking, research and future planning and design for health.

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Research Chair in Spatial Transformation
(Positive Change in the Built Environment)

Tshwane University of Technology

Faculty of Engineering and the Built Environment Department of Architecture & Industrial Design

T U T A R C H + I D

CSIR

Smart Place, Functional Building Innovation, Innovative Infrastructure

pia PRETORIA INSTITUTE FOR ARCHITECTURE A REGION OF SAIA

HEALTHY BUILDINGS HEALTHY CITIES LAB
HB&HC Lab

The HB&HCLab initiative aims to stimulate new thinking and build research and development initiatives to drive healthy building design and construction.

Towards the creation of healthy living environments at building, neighbourhood and city scale, specifically in South Africa but having resonance across Africa and globally. COVID19 and related health care associated infections (HAI), nosocomial disease burdens (TB etc.) and the contamination role of the built environment in Southern Africa and globally positions this work as critical.

The HB&HC Lab aims to stimulate transdisciplinary thinking, research and future planning and design for health in a Global post-COVID-19 world

SARChI: DST/NRF/SACN
Research Chair in Spatial Transformation
(Positive Change in the Built Environment)

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Tshwane University of Technology
We empower people

T U T A R C H + I D

We live on an island surrounded by a sea of ignorance. As our island of knowledge grows, so does the shore of our ignorance.

John Archibald Wheeler - American Theoretical Physicist 1930

We have yet much to learn…. and, much to gain in order to create healthier people-centred cities and spaces

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THANK YOU

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uia

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