The Future of Healthcare: a Design Contest for the **New Hospital in Cremona**

Ospedale di Cremona *dal 1451*

Sistema Socio Sanitario
Regione Lombardia
ASST Cremona

2 | DESIGN GUIDANCE DOCUMENT

Implementing Party
ASST of Cremona

General Manager
Giuseppe Rossi

Medical Director
Rosario Canino

Administrative Director
Gianluca Bracchi

Social and Health Director
Paola Mosa

Medical Management
Federica Pezzetti
Desireé Matteotti

Strategic Management Secretariat
Cinzia Ghezzi
Karin Nicolini
Laura Ferrari
Rossella Lazzari

Program Manager
Maurizio Bracchi

Complex Structure New Hospital
Greta Cogorno
Elena Zanibelli
Valentina Araldi
Donato Trioni

Simple Communication Structure
Stefania Mattioli
Roberta dall'Olmo
Laura Rizzi
Lidia Gallanti

With the contribution of
Manuele Gaioni

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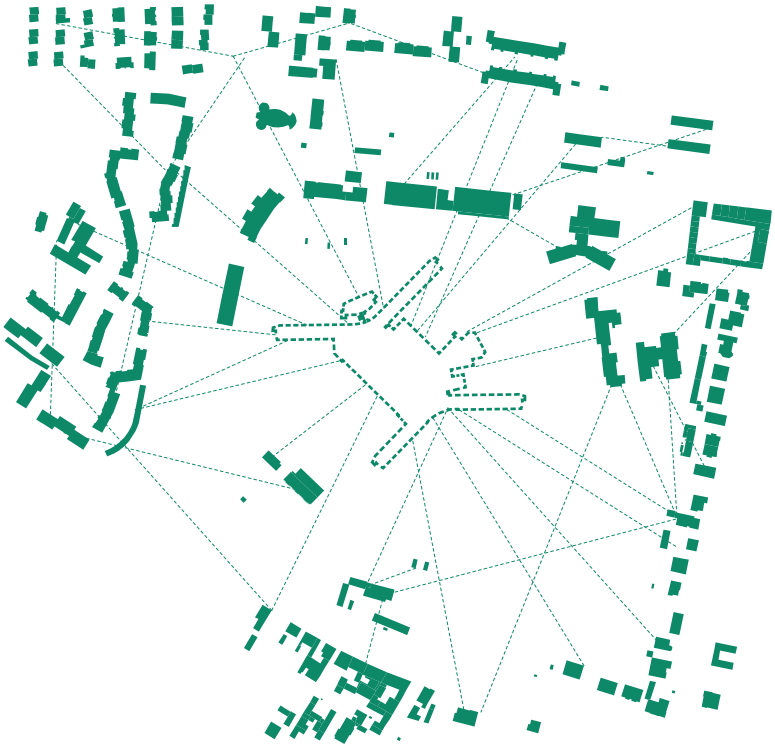
ASST Cremona

This document was produced by the Azienda Socio-Sanitaria Territoriale (ASST) of Cremona.
The purpose of the document is to provide indications and guidelines for participation in the international design competition for the New Hospital of Cremona; the contents of the document are intended only for use in the design competition described and must not be used for any other purpose.

The design references within the document are intended as a thematic and informative cue for designers; the jury's assessments will not favour a design or formal affinity to the aforementioned references.

The Future of Healthcare: a Design Contest for the **New Hospital in Cremona**



2 | DESIGN GUIDANCE DOCUMENT

Preface
The construction of the New Cremona Hospital

The construction of the New Hospital in Cremona, strongly endorsed by the Lombardy Region and comprised in its planning tools, is an **opportunity to provide a concrete response, also in terms of typological innovation of the hospital model**, to the phase of great stress to which the health system and, in particular, the public hospitals that form its backbone, has been subjected due to the pandemic spread of the Sars-CoV-2 virus.

Cremona was, with Lodi and Bergamo, among the first western cities to experience severe pandemic effects. The modern hospital typology chosen here, like nearly everywhere else, revealed all of its limitations in Cremona, sooner than almost any place else. These constraints were barely overcome owing to the effort and commitment of the medical staff and thanks to the solidarity of both local and international voluntary organisations. The aforementioned circumstances have highlighted how the hospital typological structures that are known and widespread today (the single-block, multi-block, pavilion hospital, etc.) experience **serious deficiencies including lack of flexibility, technological equipment, inadequate logistical infrastructures** and serious disconnections between their constituent sections and with the surrounding area.

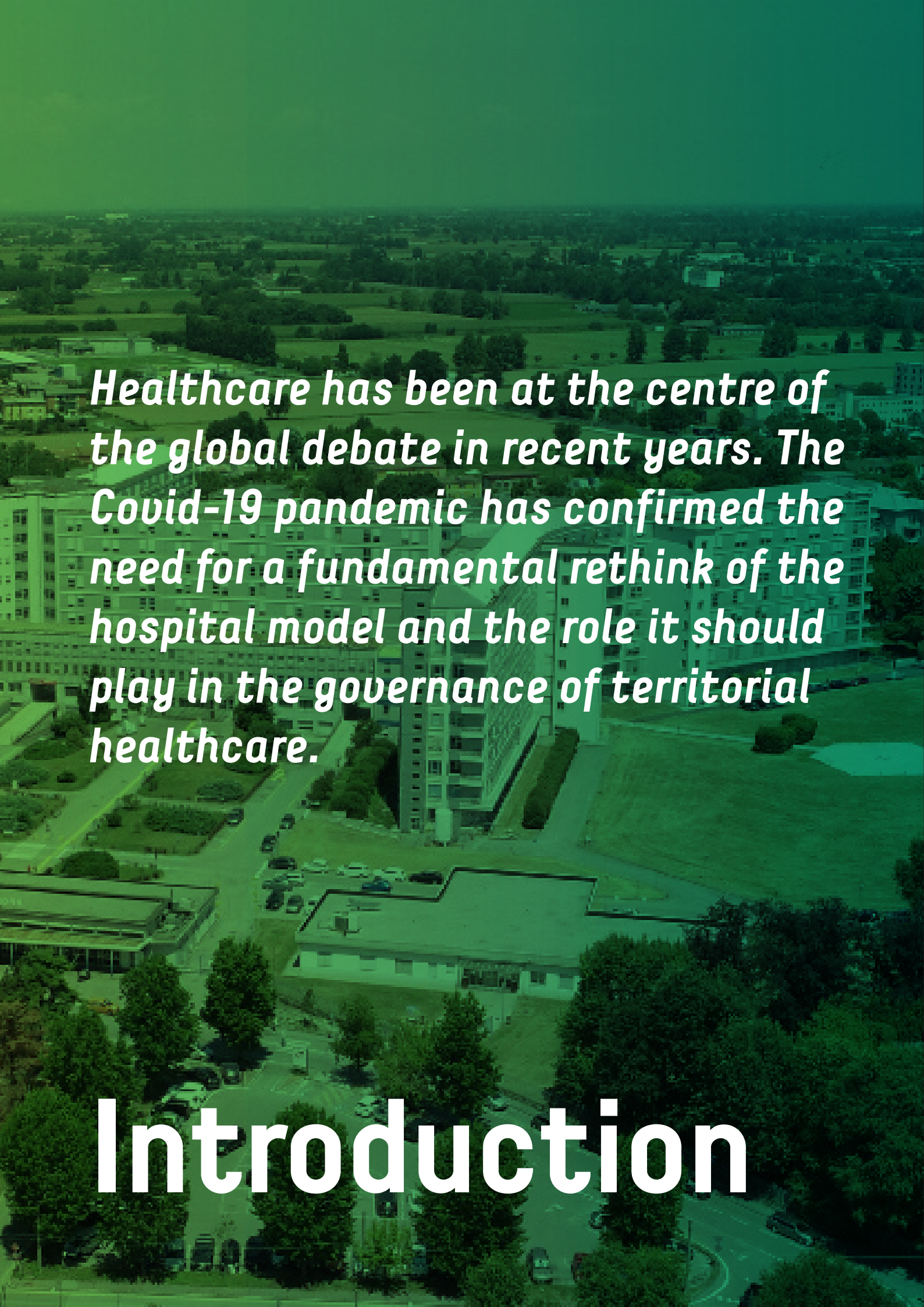
Thus, in the context briefly described above, that the **planned replacement of the present building**, to be maintained in operation for the strictly necessary period of time for the construction of the new hospital, appears to be the only way to resolve the inefficiencies, non-conformities and inadequacies mentioned above, with the additional and undoubtedly ambitious, and yet today inescapable, objective of designing, the paradigm of a new model for the hospital of the future, in Cremona's symbolic location.

It seems clear, therefore, that such an ambitious programme can only be pursued starting from the involvement of the best resources that the market of technical professionals now offers. The **call for an international design competition** is precisely aimed at fostering the interest of the most qualified professionals in the theme of strategic importance proposed here.

We believe that the value of the urban and environmental context in which the New Hospital in Cremona is located, the importance of the expected result in terms of typological, morphological and technological innovation of the building, which will be called upon to constitute a **clear paradigm for the realisation of new hospitals in the post-pandemic er**a, will provide sufficient motivation for the very best professionals to mobilise and make their skills available in the contest that is being called on the basis of this Design Guidelines Document (DPI) and the rules of the call.

Program Manager
Maurizio Bracchi

General Manager
Giuseppe Rossi



Healthcare has been at the centre of the global debate in recent years. The Covid-19 pandemic has confirmed the need for a fundamental rethink of the hospital model and the role it should play in the governance of territorial healthcare.

Introduction

context

Opened in the 1970s, the Cremona Hospital is currently in a **dysfunctional and non-compliant state that requires radical reform**. The assessment of the state of the art has led to the definition of two possible scenarios: renovation or building replacement. Following in-depth and complex analyses, carried out by the Cremona ASST and shared with the competent regional directorates and structures, it became clear that restructuring the existing hospital would entail a substantial investment without any possibility of achieving even the least objectives of functionality, adequacy and sustainability. Instead, the decision to build a new construction offers the **great opportunity to create a new hospital model that is more flexible and suitable for accommodating the constant evolutions of the healthcare system**, for dealing with possible healthcare emergencies, and for making the best use of the most up-to-date technological innovations in the management of clinical processes, even at a regional scale.

With the aim of laying the foundations for a new hospital model, it is essential that the project for Cremona's New Hospital begins from the **definition of the new requirements, the different dynamics currently guiding the governance of healthcare, and the technological innovations** that can favour the condition and management of clinical processes and their diffusion throughout the region. The design is driven by the definition of an **integrated model for a digital and technology strategy**, aimed at streamlining and optimising processes and improving the patient and staff experience. The design becomes the container for this new model, adapts to it to make it work and remains flexible and open for future implementations.

opportunities

The definition of an integrated model for digital and technological strategy, aimed at **streamlining and optimising processes and improving the patient and staff experience**, and its framing according to type-morphological canons characterised by flexibility and sustainability, must guide the design. In this context, architecture cannot but become the shell of a new functional and organisational model, and adjust to it to make it possible and remain flexible and open to any future implementation.

- **Rebuilding the Cremona Hospital:** building a new structure to replace the existing hospital, updated and optimised, able to provide quality service to all users;

- **Defining a new hospital model:** innovation in strategies, technologies and typological and organisational models, in order to
- / responding adequately to **new requirements and changes in the discipline** of health care also at the territorial scale;
- / offering **flexibility and adaptability to future changes** also in response to possible emergency situations;
- / creating a structure that is properly **integrated into the urban and environmental context**, with a reduced ecological footprint
- / positioning the New Hospital of Cremona as a typological model, an **example of international best practice on the subject of the hospital of the future.**

Proponents

The '**New Cremona Hospital' International Design Competition** is promoted by the Cremona ASST in implementation of programmatic indications deliberated by the Regional Council of Lombardy
The **Cremona Local Health Authority (ASST),** through its structural organisation, guarantees the provision of services pertaining to both the 'Hospital Centre' and the 'Regional Centre' corporate sectors.

The **'Hospital Centre'** consists of two hospital wards:
/ Presidio Ospedaliero di Cremona, (the hospital in Cremona): located in Viale Concordia no. 1, in Cremona, it consists of a central monobloc and 8 surrounding pavilions.
/ Presidio Ospedaliero Oglio Po, (the hospital in Oglio Po).

The **'Regional Centre'** consists of widespread delivery structures such as:
/ Regional Child Neuropsychiatry;
/ Cremona Psycho-Social Centre (CPS);
/ Family nursing service;
/ Former psychiatric hospital;
/ Casalmaggiore Community House;
/ Community House and Hospital in Soresina.

The object of the competition consists in the **design of a New Hospital within the Cremona Hospital area**, to replace the central monobloc located in Viale Concordia no. 1, which will be demolished at a later date.

Hospital of Cremona

Hospital of Oglio Po

Hospital of Soresina Community

Territorial Services of Cremona and Casalmaggiore

Sistema Socio Sanitario
Regione Lombardia
ASST Cremona

Objectives

The Cremona ASST announces the 'New Hospital in Cremona' international design competition with the aim of **outlining a new hospital structure to be placed at the service of the regional health service network**, and which will serve as a model of innovation and sustainability for the hospitals of the future.
The path to the construction of the New Hospital is constantly monitored by a **Working Group** comprising ASST Cremona, ATS Valpadana, the Lombardy Region, the Municipality and the Province of Cremona.

Participants in the competition are invited to respond to the challenges outlined in this document. In particular:

- How will the New Hospital adapt to the **changing requirements, dynamics, habits and innovations** of the healthcare system?
- How will the New Hospital promote **innovation, efficiency and flexibility for the future**?
- How will the New Hospital ensure the **safety and well-being of patients and staff**?
- How will the New Hospital **minimise its environmental impact**?

The design competition a tool for quality

Object of the competition

The international design competition 'New Hospital in Cremona' has as its object the **acquisition of a project with a level of detail equal to that of a technical and economic feasibility project**.

Positive evaluation will be given to design proposals whose **architectural language** will be able to interact coherently with the urban and environmental context and accurately connote the building within Cremona's cultural and social environment and the most current orientations that qualify contemporary architecture, of which the building must be a valid reflection.

Indications and evaluations

/ responding to the proposed challenges and guidelines described within this document;

/ overcoming 'Business-As-Usual': designers are required to demonstrate how their proposal goes beyond the Business-As-Usual approach and brings innovative strategies to best meet environmental, social and architectural requirements;

/ complying with local regulations and mandatory sustainability standards for construction in Italy: the participating designers will have to demonstrate how their proposal respects and meets national regulations for construction in the project area, in terms of space standards, use of materials, structural compliance and certifications.

Designers are encouraged to design by **applying sustainability standards** such as the European Taxonomy classification, LEED BD+C Healthcare certification, the WELL protocol, etc.

How to read the document
structure and language

Competition Documentation

This document **"Design Guidance Document"** is structured in **two parts**:

Part 1 - Vision and Guidelines
- **Chapter 1:** Context
- **Chapter 2:** Vision and Objectives
- **Chapter 3:** Design Guidelines
- **Chapter 4:** Patient Journey
- **Chapter 5:** Bibliography
- **Chapter 6:** Appendix

Part 2 - Requirements
- **Chapter 1:** Equipment
- **Chapter 2:** Functional Programmes
- **Chapter 3:** Functional relationships

Example of content and guide to reading the Guidelines

guideline title and subtitle

goals description

design recommendations

NEW HOSPITAL OF CREMONA

Orientation
wayfinding design and signage

Universal accessibility

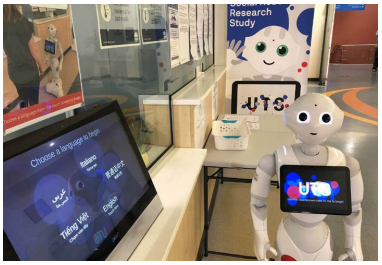
Interior and exterior spaces must be designed with respect to **visibility and recognizability of main functions and destinations**, to ensure comprehensibility and ease of reading of the space.

The distribution of functions must be **logical and easy and intuitive** to understand, and the architectural elements must help to **facilitate user orientation**. Orientation within the New Hospital must be clear and assisted along all routes, both through a linear and comprehensible design of the spaces, and through universal and continuous signage.

The **wayfinding strategy** must be designed seamlessly between outdoor and indoor spaces: the route must be able to easily lead the different users from the access to the Health Park to the interior of the buildings and individual rooms. The signage should be **universal and inclusive**, open to innovative solutions and integrating physical and digital strategies.

Guidelines

- Development of a **rational and intuitive distribution** to the main functions;
- Provision of **architectural elements** (colours, volumes, materials) and **spatial landmarks** to facilitate orientation;
- Implementation of an orientation and **wayfinding strategy** dedicated to different types of flows and mobility (road, bicycle, pedestrian, etc.);
- Design of **universal and inclusive** signage, accessible and understandable to different types of users, considering for example different types of language (foreign languages, blind or deaf people, etc.) and physical needs (height of information suitable for wheelchair users, children, elderly people, etc.);
- Use of integrated signage **between the external and internal spaces** of the New Hospital;
- Implementation of an integrated wayfinding **strategy between physical and digital**, through e.g. interactive navigators (totems, screens, projections, robots, etc.), customised information, multi-channel digital applications, etc.



FAIRFIELD HOSPITAL, SYDNEY
The small robot welcomes patients and visitors at the entrance; it speaks five languages, displays digital maps or videos, and gives verbal and gestural directions. Social behaviours, such as turning and pointing, help people better understand information.

Lesson learned:
An interactive orientation system provides personalized information to users, minimizing time and freeing up staff at the hospital entrance.

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SENSE OF COMPREHENSIBILITY[5]
One of the essential elements in the notion of "**salutogenic design**," is comprehensibility and it refers to the capacity to understand one's surroundings and see them as orderly, clear, and organized.

Design may make a space more understandable, for instance, by emphasizing more intuitive routes or by using orientation systems (including colours, landmarks, natural light and views of nature, etc.)

LADY CILENTO CHILDREN'S HOSPITAL, BRISBANE, AUSTRALIA
Architecture and wayfinding work together from the very beginning of the project, creating an integrated orientation system that includes volumes, distribution spaces, materials, colours and environmental graphics that add a sense of joy and vibrancy to the hospital.

Lesson learned:
The orientation system is an integral part of the design and is composed not only of signage, but also of distribution strategies and architectural elements.

69

mood images

thematic insight

design reference or best practice

"lesson learned" from the design reference or best practice

link to design reference or best practice

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Part 1
Vision and Guidelines

1

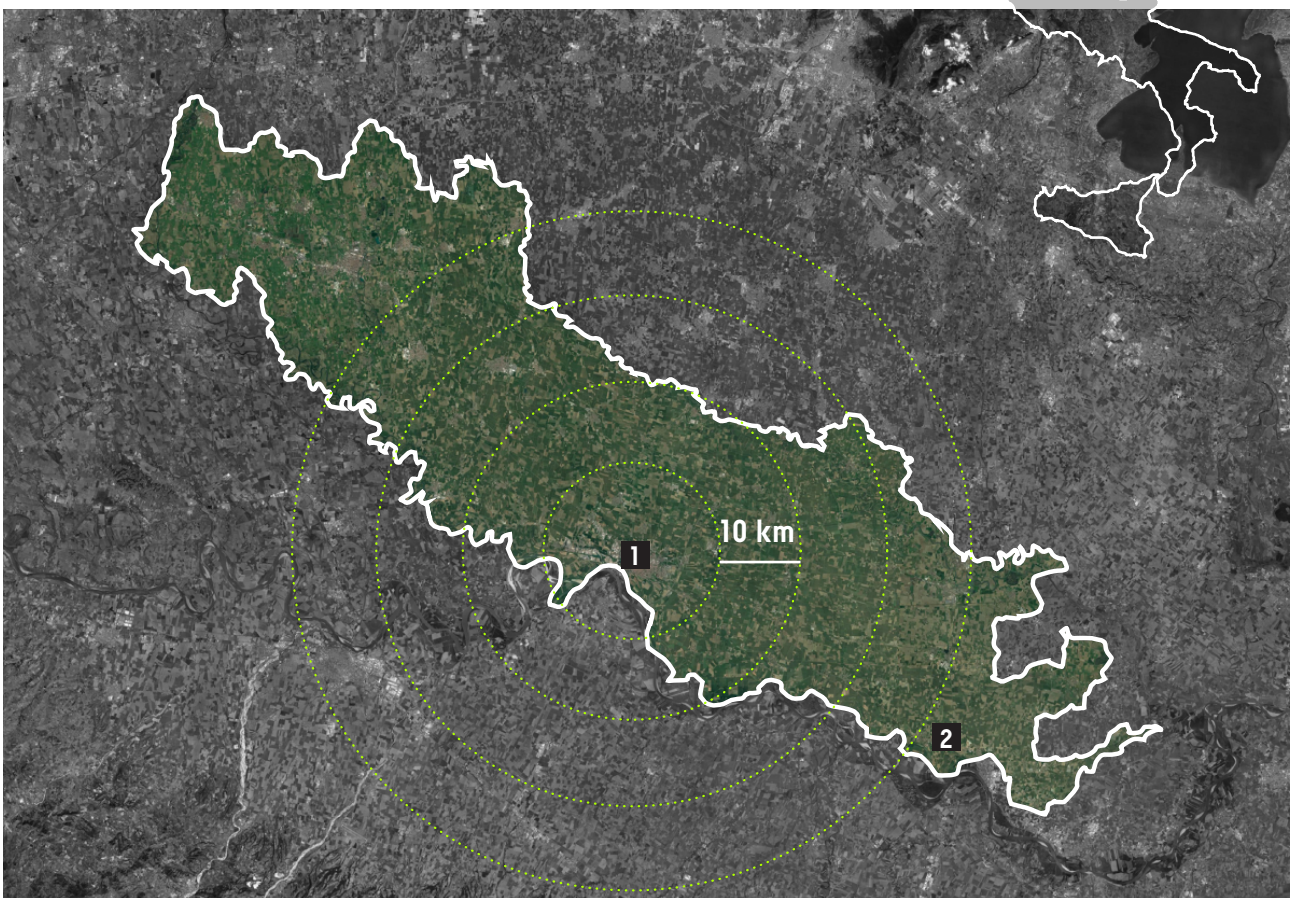
Context Cremona hospital

Cremona Hospital
analysis of the territory

Regional reference

In terms of surface area and population served, the regional reference of **Cremona's Local Health Care Area - ASST** consists of a significant portion of the Cremona province. The Cremona ASST is one of the three Companies of the **Regional Health Service of Lombardy** regulated by the ATS (health protection agency) of the Po Valley. The regional area of the Cremona ASST extends over 1,166 km2 (about 5% of the regional territory) and with its 194,632 inhabitants (1.9% of the resident population of the Lombardy region) has a population density of about 167 inhabitants/km2, a value almost in line with that recorded by the health protection agency -**ATS Val Padana**, which is considerably lower than the Lombardy population density value.

FIG. 1 *Territorial reference of the ASST of Cremona*



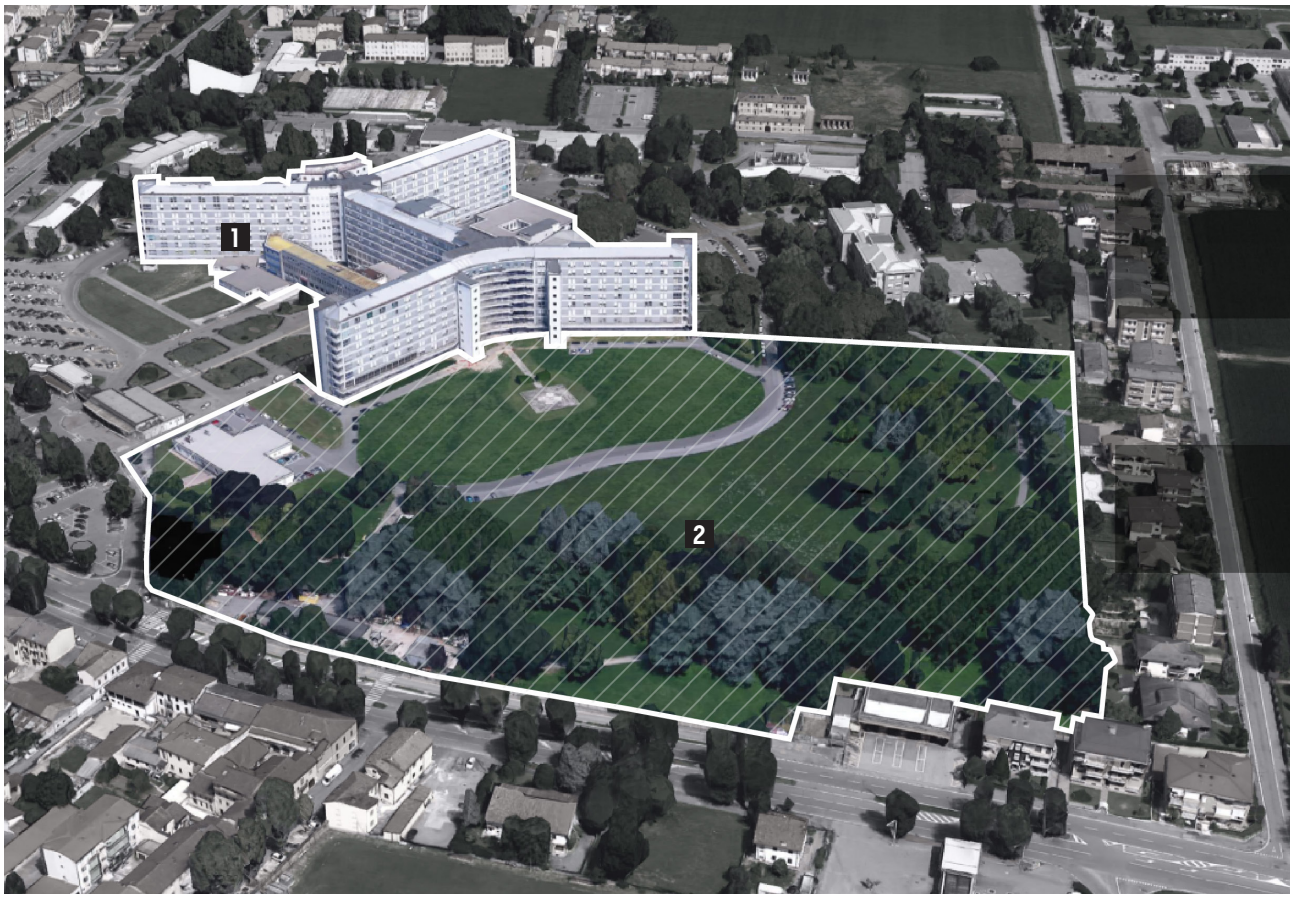
1 Hospital of Cremona

2 Oglio Po Hospital

The project area

The construction of the New Hospital in Cremona is an objective that can be pursued through a **building replacement operation**. The current hospital complex has an appurtenant area of 18.5 hectares, of which only 13.5% is occupied by the existing buildings. The area is therefore able to accommodate the construction of the New Hospital, **guaranteeing the regular continuation of clinical-diagnostic activities** and those instrumental to them provided by the existing structure. Therefore, it is necessary to demolish the single-block structure and a few pavilions and transfer them inside the confines of the current hospital complex, as well as relocate them with the aid of outpatient hub facilities and tele-care at home (for more details see the "Appendix").

FIG. 2 *Identification of the project area within the lot*



1 Current hospital of Cremona, single-block building

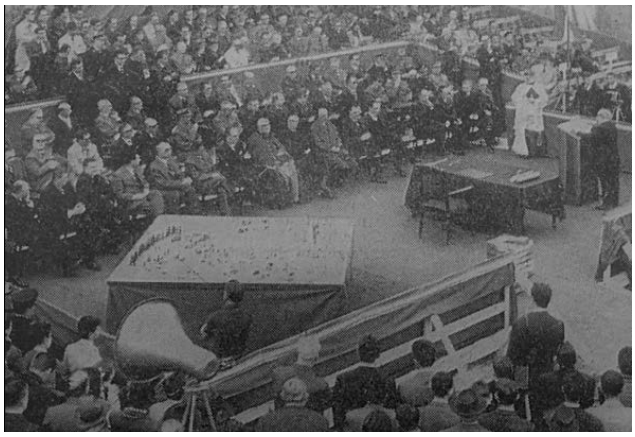
2 Project area for the New Hospital

Cremona Hospital over time
evolutions in history

1451

THE FIRST HOSPITAL: SANTA MARIA DELLA PIETÀ

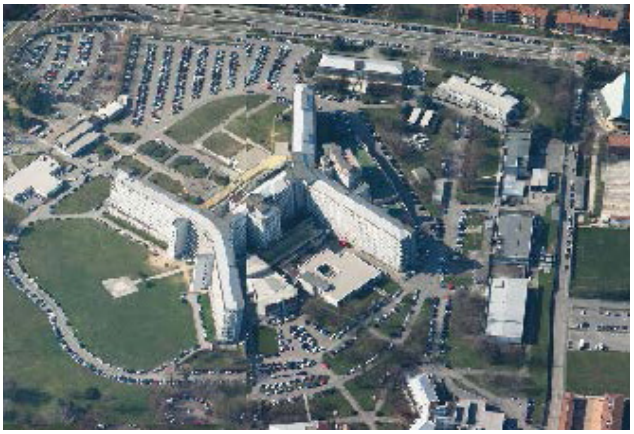
Cremona's Hospital was born out of an outbreak of the plague, following the example of the Ospedale Maggiore in Milan Ca' Granda, which was founded in 1456 on the design of a cross-shaped hospital model by architect Antonio di Pietro Averlino, or Averulino, known as the Filarete.



1965

THE NEW HOSPITAL: OSPEDALE MAGGIORE

The foundation stone was laid for the Ospedale Maggiore, completed in 1970 (single-block hospital model). The hospital currently has potentially 1,250 beds, of which only about 500 are actually in use.



2019

CRITICALITIES: EVALUATION AND SCENARIOS

Oversized and inefficient, the Cremona hospital centre requires a substantial rethink. From an initial assessment of the state of the art, the following possible scenarios were first considered:

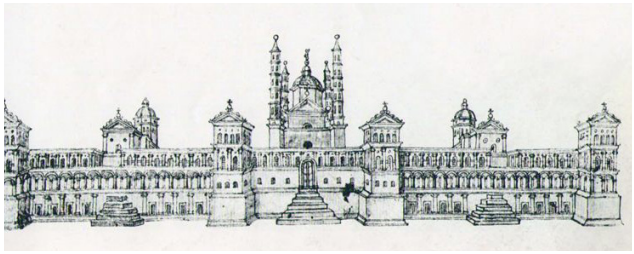
- Restructuring: adaptation works on the building in phases (duration approx. 15 years, investment approx. € 200 million)
- Building replacement: construction of a new hospital and demolition of the current building, comprising a Health Park.

2021

COVID-19: STRUCTURE COLLAPSE

During the SARS-CoV-2 pandemic crisis, the 500 beds were almost entirely occupied by patients suffering from Covid-19, leading to a situation of substantial collapse of the facility, which was coped with thanks to the sacrifice and self-sacrifice of the medical staff and with the help of a field hospital set up by an American NGO that could accommodate an additional 100 ICU beds.

Hospital models
evolutions in history



1456

CROSS-SHAPED HOSPITAL

The cross-shaped hospital is organised along a central axis. The aim is to place the altar, a religious symbol visible to all patients in the facility, at the centre.

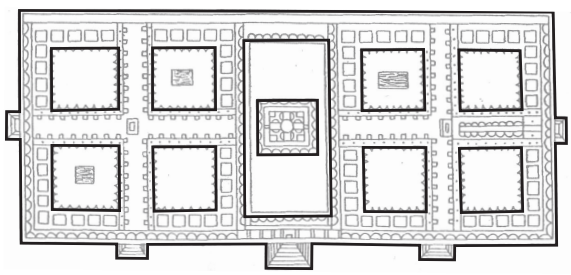
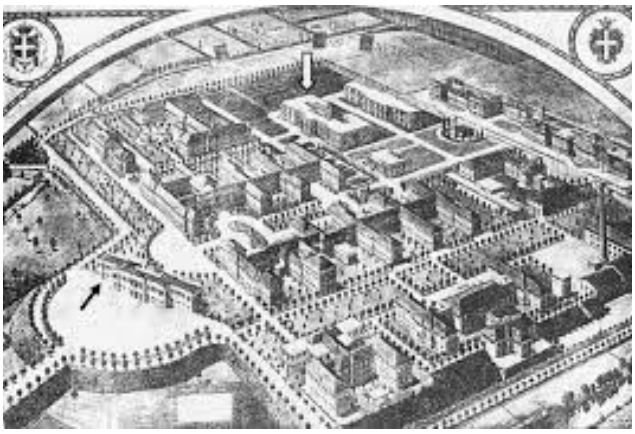


FIG. 3 *Ca' Granda - Milano*



1449

PAVILION HOSPITAL

The pavilion hospital was born as an evolution of the cruciform hospital and arose from the need to dedicate separate hospitalisation areas to patients according to different pathologies in separate pavilions.

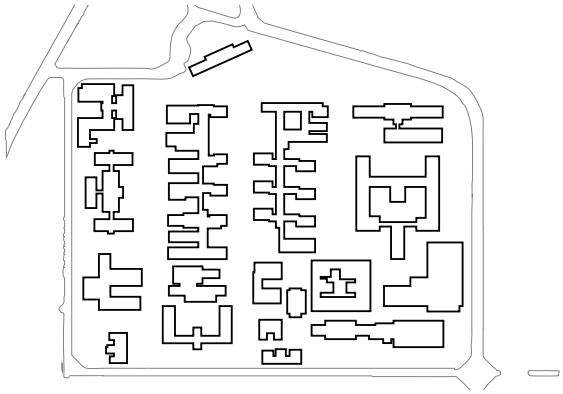
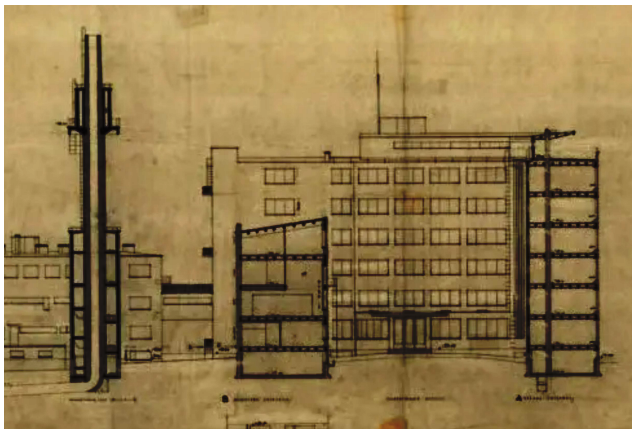


FIG. 4 *San Matteo - Pavia*

Hospital type models have evolved to adapt to new needs and technical achievements. In recent years, the need for a new development has become apparent. What will the hospital model of the future be?



?

1933

MONOBLOCK / POLYBLOCK

In the block model, we observe a vertical arrangement of the pavilion facility, made possible by updated construction techniques. This model allows the greatest number of patients to be placed in the same structure.

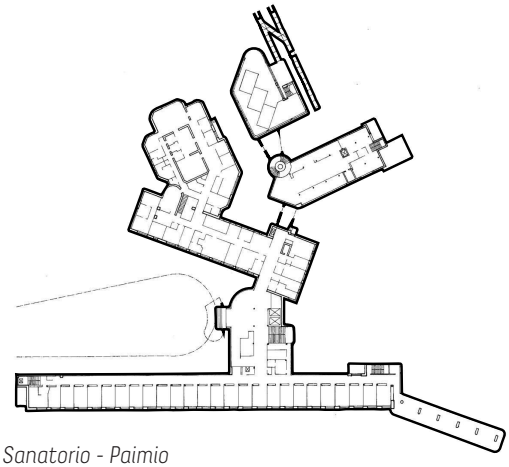


FIG. 5 *Sanatorio - Paimio*

TODAY

TOWARDS A NEW HOSPITAL MODEL

The crisis caused by the pandemic has triggered a rethink of the typological models consolidated over time, since the current model is not able to support emergencies of this type. Therefore, the Cremona ASST has set itself the great challenge of updating its hospital model.

Swot analysis
Cremona Hospital

STRENGHTS

- Freedom to rethink the functional and structural distribution model
- Freedom to rethink the system of flows and internal mobility
- Freedom to define an integrated strategy for sustainability
- Freedom to implement new technologies and automate processes and services
- Freedom to implement new monitoring and management technologies
- Freedom to define a new design and architectural quality
- Freedom of decentralisation and self-sufficiency in data management
- Freedom to redefine access based on current trends and future forecasts
- Public transport system already in place and being expanded
- Transverse pedestrian axes with hospital destination
- Very large green area (also following demolition of existing hospital)

S

OPPORTUNITIES

- Promotion of flexible spaces that can also be implemented through modular building systems
- Definition of optimised and differentiated routes for users/goods
- Ambitions of net zero carbon, energy efficiency, self-sufficiency and circular economy
- Integration of technologies to automate processes and customise the space
- "*Digital twin*" for real-time monitoring and regulation of consumption and operations
- Design with patient and staff at the centre, attention to quality of space and materials
- Data management and utilisation, data policy, artificial intelligence and space virtualisation
- Reorganisation of vehicle flows and adaptation to new forms of access (drones)
- Adaptation of bicycle and pedestrian routes, enhancement of the multi-modal mobility system
- Reconnecting the area's urban pedestrian crossing system
- New health park, permeable and open to the city and with non-health services
- Promotion of predominantly off-site construction techniques

O

Through the SWOT Analysis, the strengths (Strenghts) and weaknesses (Weaknesses) of the issues concerning the morphological and functional characteristics of the Cremona Hospital are described and systematised with the opportunities (Opportunities) and threats (Threats).

WEAKNESSES

- Rigidity of spaces and facilities, inadequate dimensioning (use of 1/3 beds)
- Poorly differentiated internal flows and rigid and insufficient connective spaces
- Poor energy efficiency (hospital as 'energy-hungry machine')
- Obsolete technologies and repetitive staff operations that can be automated
- Limited ability to control operations
- Sub-optimal quality of space and architecture
- Centralised, server-dependent data management
- Access by other users mainly by vehicle (private car)
- Physical disconnection between the hospital area and the outside world
- Park currently as leftover green areas

W

THREATS

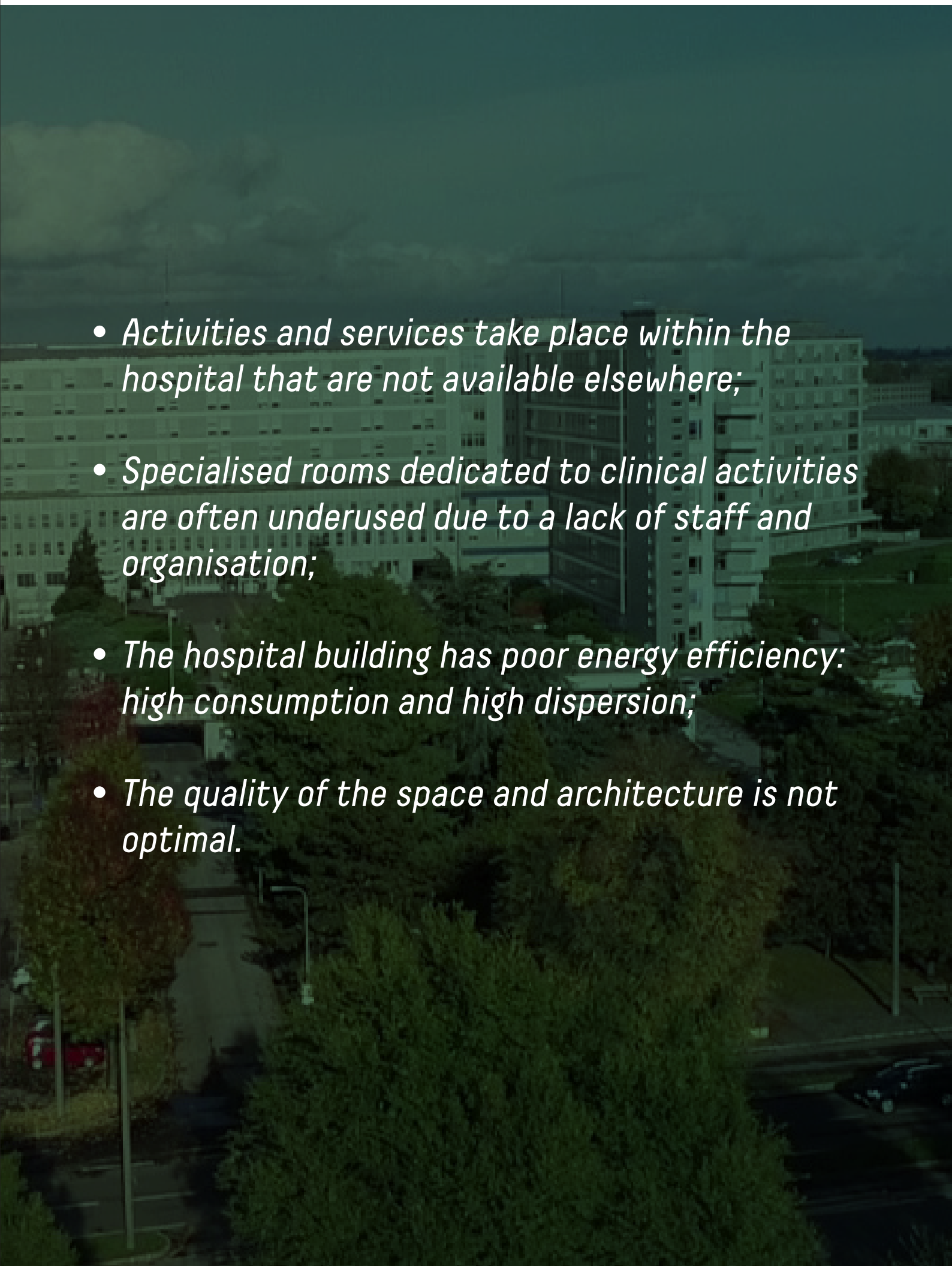
- Necessity to define rapid and effective implementation strategies
- Necessity to increase connective space to separate flows
- Necessity for strategies that are feasible in the short term and open to future implementation
- Necessity to integrate technology systems that can be implemented and upgraded when obsolete
- Necessity to define a parametric model of the new hospital from the design phase
- Necessity to provide a design adaptable to changing user needs
- Necessity for secure data sharing strategies
- Necessity to define current flow optimisation strategies that can be implemented in the future
- Reduction in the area dedicated to vehicular mobility and dissent among users
- Necessity for management of new pedestrian flows and 'soft' boundary strategies
- Necessity of green management strategies and park functions
- Necessity of limit disruptions to the existing hospital during construction (e.g. vibrations)

T

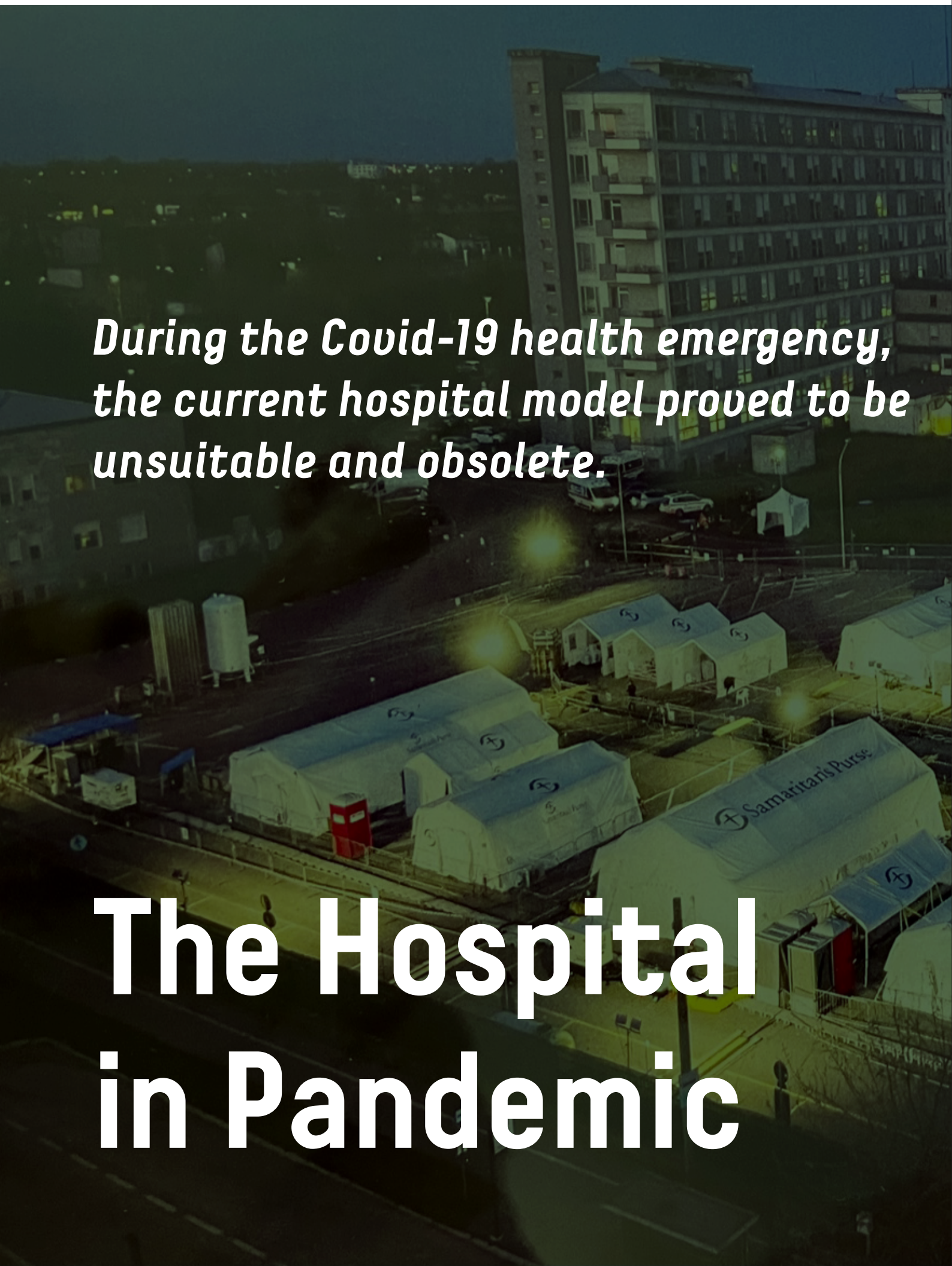
2 Vision and objectives

Today, the hospital is organised around the health system, not the patient. Hospital systems are mainly focused on acute care, medical specialisation and technology: the focus is on medical expertise to the detriment of people's care pathway.[1]

The Hospital Today

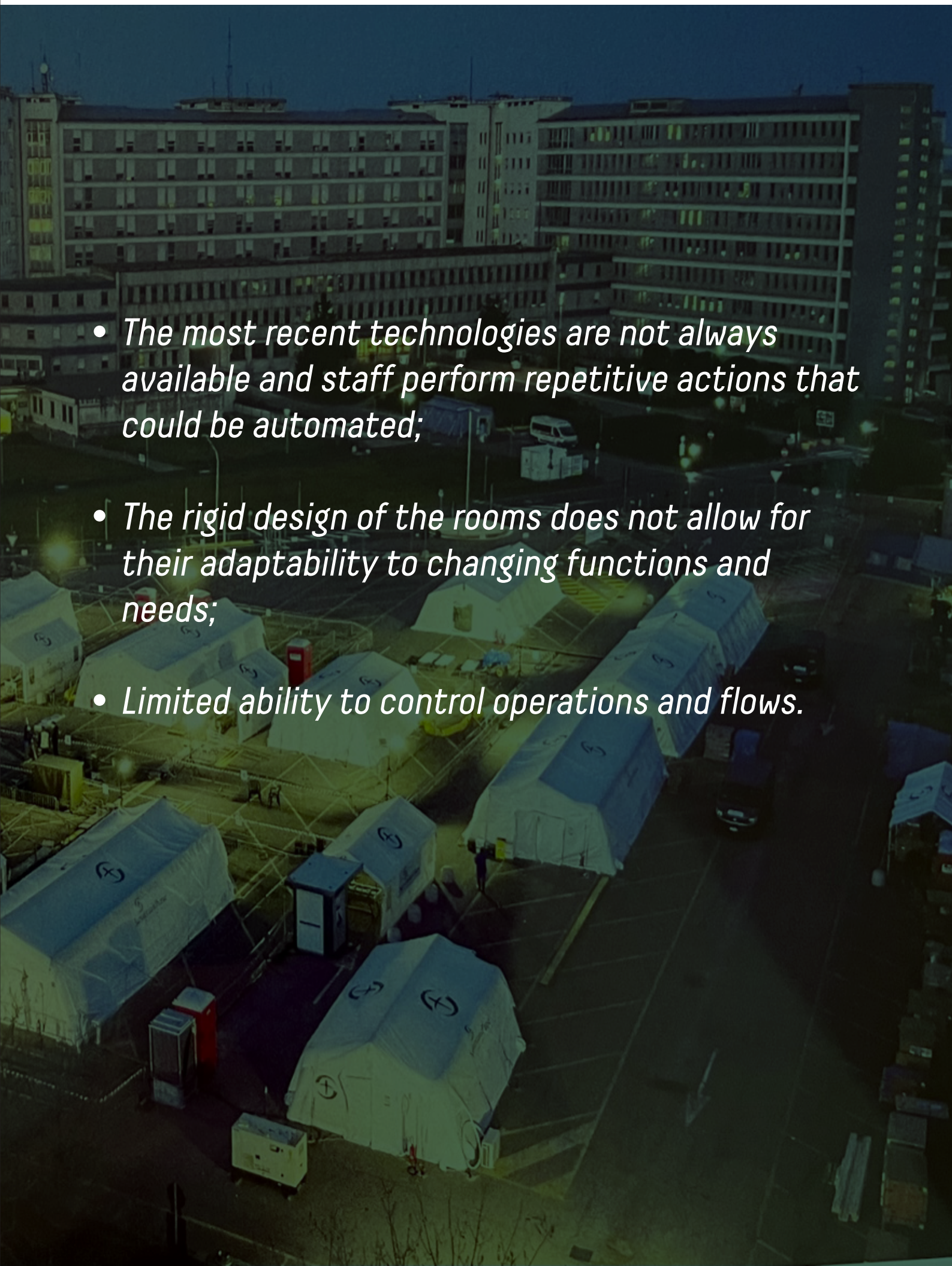


- *Activities and services take place within the hospital that are not available elsewhere;*
- *Specialised rooms dedicated to clinical activities are often underused due to a lack of staff and organisation;*
- *The hospital building has poor energy efficiency: high consumption and high dispersion;*
- *The quality of the space and architecture is not optimal.*



During the Covid-19 health emergency, the current hospital model proved to be unsuitable and obsolete.

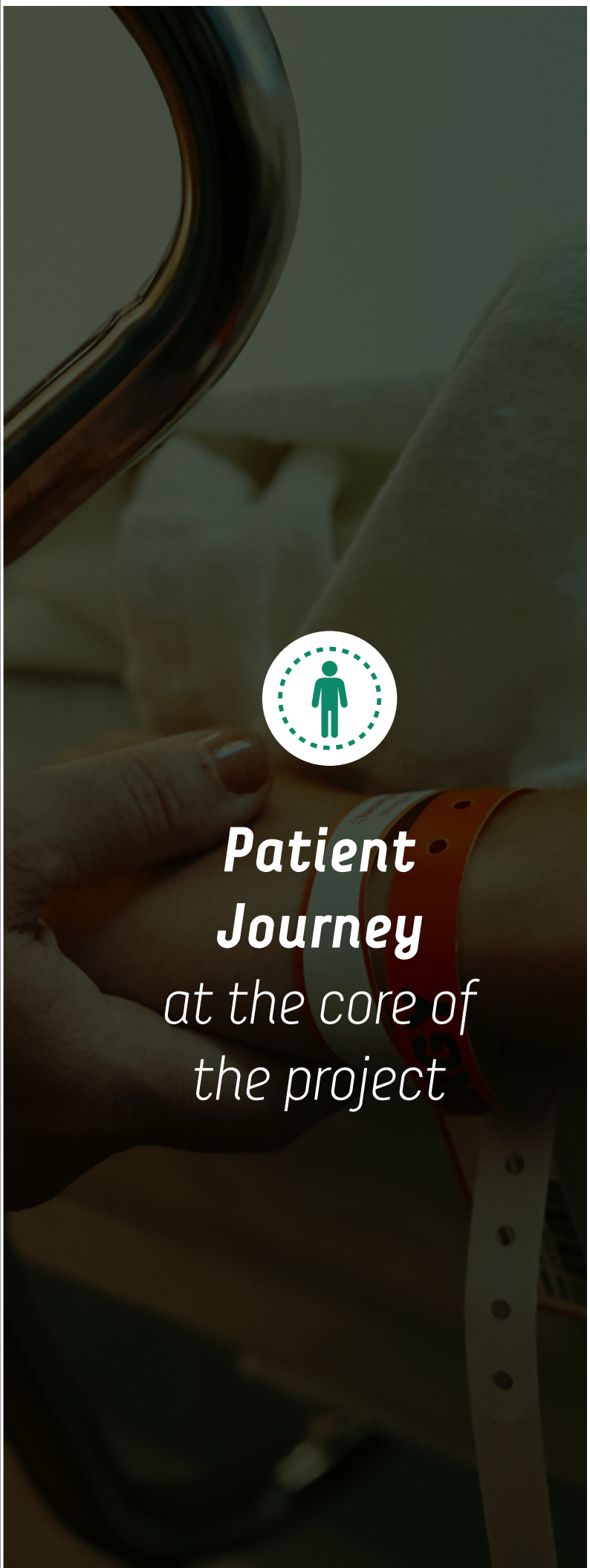
The Hospital in Pandemic



- *The most recent technologies are not always available and staff perform repetitive actions that could be automated;*
- *The rigid design of the rooms does not allow for their adaptability to changing functions and needs;*
- *Limited ability to control operations and flows.*

The hospital as a network
delocalised and connected

Wellness for the ecosystem
harmony between species

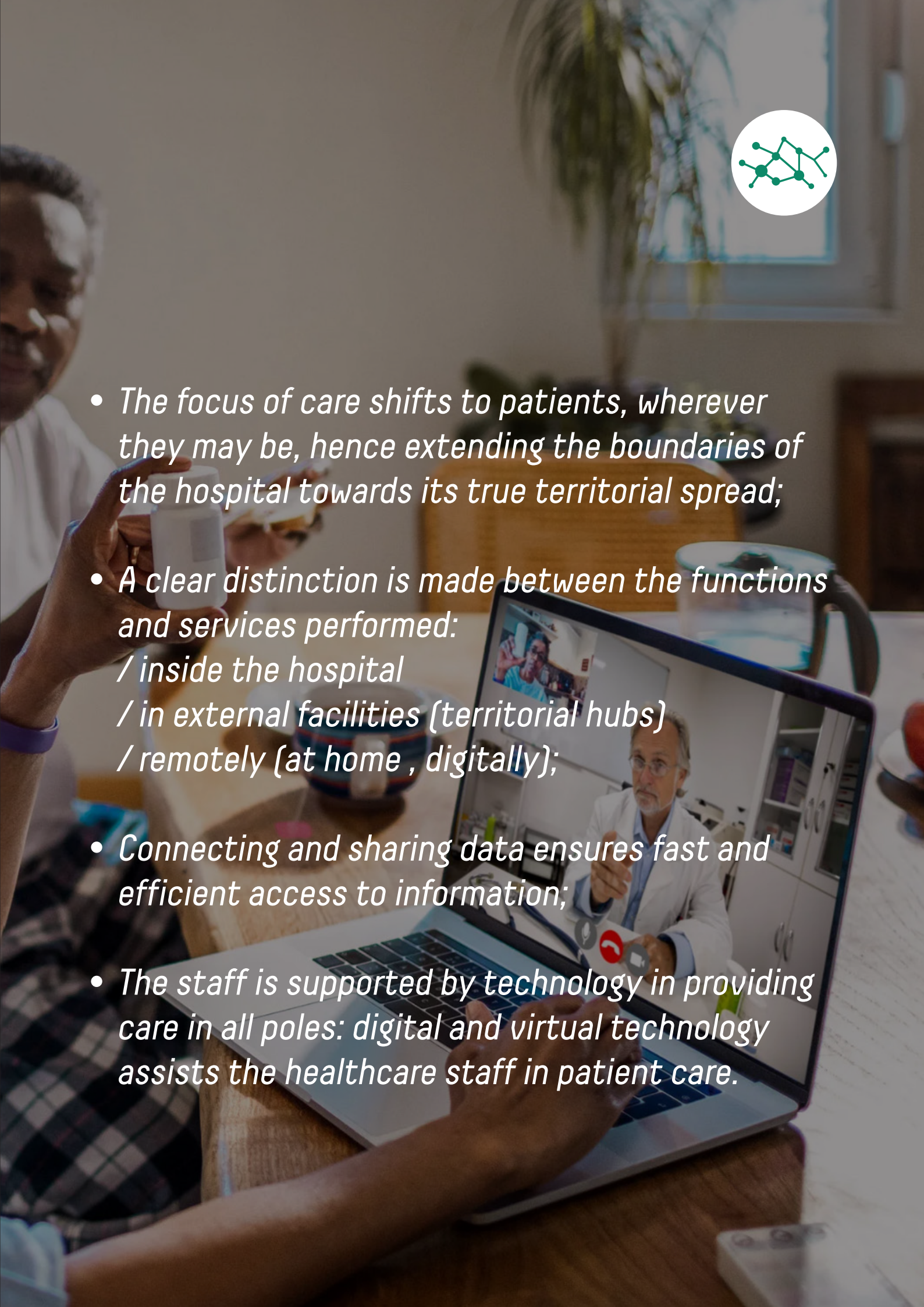


Patient Journey
at the core of the project

Opening up to the city
gradient between private and public

Digitisation allows 24/7 access to data and connection with patients, wherever they are located, and with external clinics.
The hospital becomes a hub for the management of serious and acute conditions: operations and services that can be carried out externally are relocated and the management of clinical functions located in the territory must be given special space and adequate technological equipment at the disposal of the medical staff.

The hospital as a network



- *The focus of care shifts to patients, wherever they may be, hence extending the boundaries of the hospital towards its true territorial spread;*

- *A clear distinction is made between the functions and services performed:*
  / inside the hospital
  / in external facilities (territorial hubs)
  / remotely (at home , digitally);

- *Connecting and sharing data ensures fast and efficient access to information;*

- *The staff is supported by technology in providing care in all poles: digital and virtual technology assists the healthcare staff in patient care.*

The hospital as a network program

The functions of Cremona Hospital today

Overall dimensioning of Cremona's Hospital structure, in particular of the central monoblock that will be subject to demolition and reconstruction.
The dimensioning was indicatively determined on the basis of available floor plans.

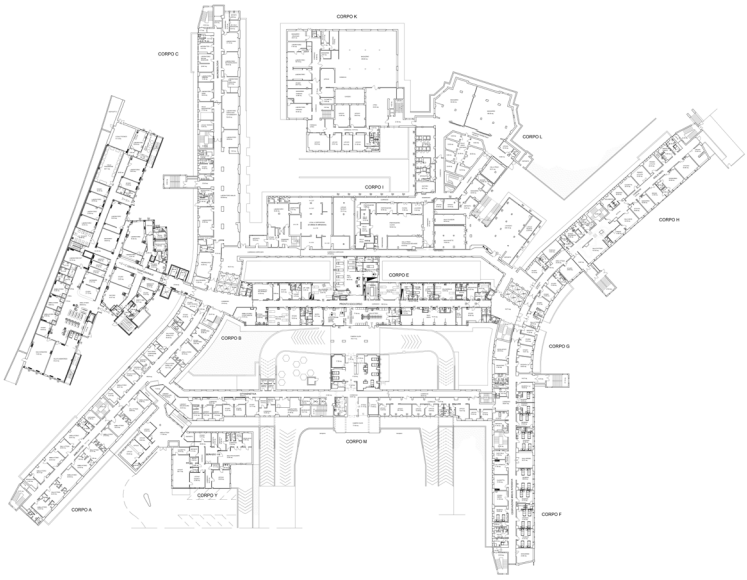


FIG. 6 *Ground Floor Plan, Cremona Hospital, Monoblock Building*

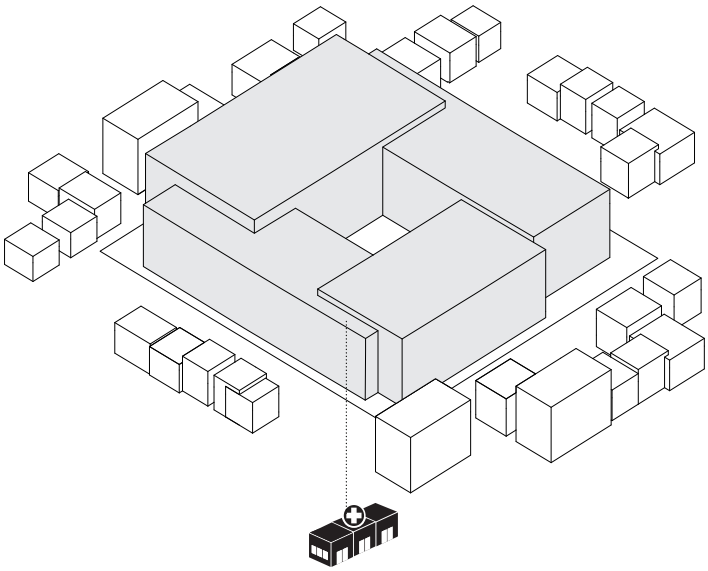


FIG. 7 *Conceptual diagram: today's hospital as a large single block in which all healthcare activities take place*

basement	• Economy Warehouse	1000	**11.700**
	• Pharmacy warehouse	1200	
	• Decontamination center and lab. dosimetry	500	
	• Office warehouse	1300	
	• Dialysis warehouse, thermal power station	6500	
	• Electrical workshop	1000	
	• Radiotherapy	3000	
	• Thermal substation	1500	
ground floor	• Nursery	1000	**13.500**
	• Cardiology, echocardiography	1200	
	• Transfusion Center	1800	
	• Cytogenetics	1100	
	• Kitchens and washing	1500	
	• Warehouses and cold rooms	1200	
	• Pharmacy warehouse and offices	1300	
	• Microbiology	1100	
	• Intensive brief observation	1200	
	• Emergency room	1200	
	• Services	600	
	• Education	300	
mezzanine	• Church and great hall	1100	**11.200**
	• Management and offices	1200	
	• Hemodialysis, nephrology and dialysis	1200	
	• Cafeteria	1300	
	• Nephrology	1100	
	• Pediatrics-hospitalizations	1000	
	• Operating plate	1900	
	• Changing rooms, bars, newsagents	1400	
	• NICU U.O. Pediatrics	1000	
1ST floor	• Lodging spiritual assistants	300	**8.500**
	• Dermatology, Rep.Covid, diagnostics	1400	
	• Ultrasound, Angiography	1000	
	• Pulmonology	1000	
	• Radiology	1300	
	• Central sterilization service	1200	
	• Studios, service center, plaster room	1200	
	• U.O. Functional rehabilitation	1100	
2ND floor	• Respiratory physiotherapy	1000	**7.100**
	• Neurosurgery	1100	
	• Neurology, Neurosurgery	500	
	• Psychological studies, child neuropsychiatry	1000	
	• U.O. Legal and occupational medicine	1000	
	• U.O. Oncology	1300	
	• U.O. Orthopedics and traumatology	1200	
3RD floor	• Nursing training classrooms	1000	**6.200**
	• Cardiology, sub intensive	1000	
	• General surgery	1300	
	• Multispecialty surgery	1200	
	• Stores	500	
	• Gastroenterology and endoscopy service	1200	
4TH floor	• Outpatient clinic, sampling rooms	300	**6.500**
	• Oncology area	1200	
	• Surgery, breasts	1200	
	• Oncology day hospital	1000	
	• Pharmacogenomics laboratory	250	
	• Molecular therapy clinic	250	
	• Neurology	1100	
	• Waiting rooms and medical office, changing rooms	1200	
5TH floor	• ENT clinics	1100	**5.900**
	• Hematology	1000	
	• Former operating block (changing room)	400	
	• Internal medicine section A&B	2200	
	• Dietetics and chemical nutrition	200	
	• Vascular surgery clinic	1000	
6TH floor	• Eye clinics	1200	**5.900**
	• Surgical unit	400	
	• diabetes center	1000	
	• Day surgery	1100	
	• Empty premises	1000	
	• MAC clinics	1200	
7TH floor	• Gynecology	1000	**5.900**
	• Future intensive care	1100	
	• Empty premises	400	
	• Obstetrics	1000	
	• Intensive care	1200	
	• U.O. Obstetrics and Gynecology	1200	

Hospital

The hospital as a network
delocalised and connected

Delocalisation of the hospital system

The hospital of the future will no longer be a huge building capable of accommodating patients with any pathology. The hospital will be dedicated primarily to the treatment of serious illnesses and the performance of complex procedures. Routine treatment and preventive care will be **distributed through neighbourhood clinics and hubs**, connected and spread across the region.

The **patient's home will also be part of this connected ecosystem** thanks to smart diagnostic devices connected 24/7 with control centres, through which doctors will be able to monitor the patient's health status in real time, even at home. Artificial Intelligence will be used to **optimise processes and define predictive models** to protect vulnerable individuals before they have to reach the hospital. [1]

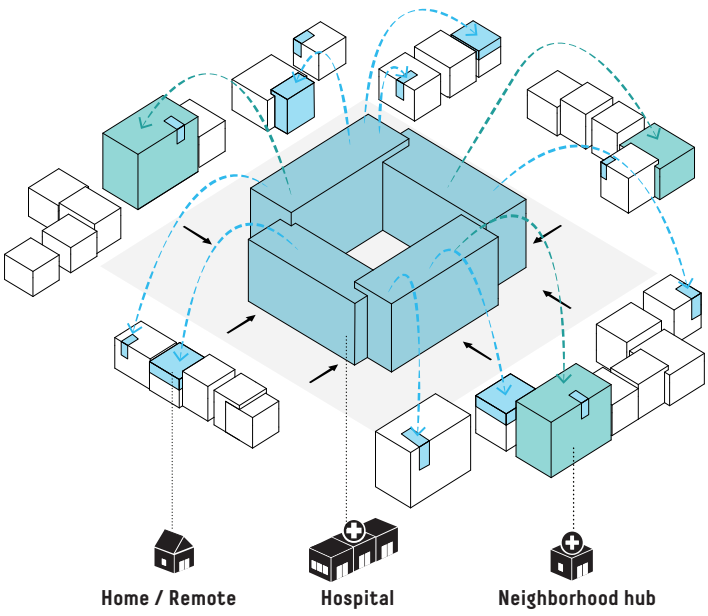
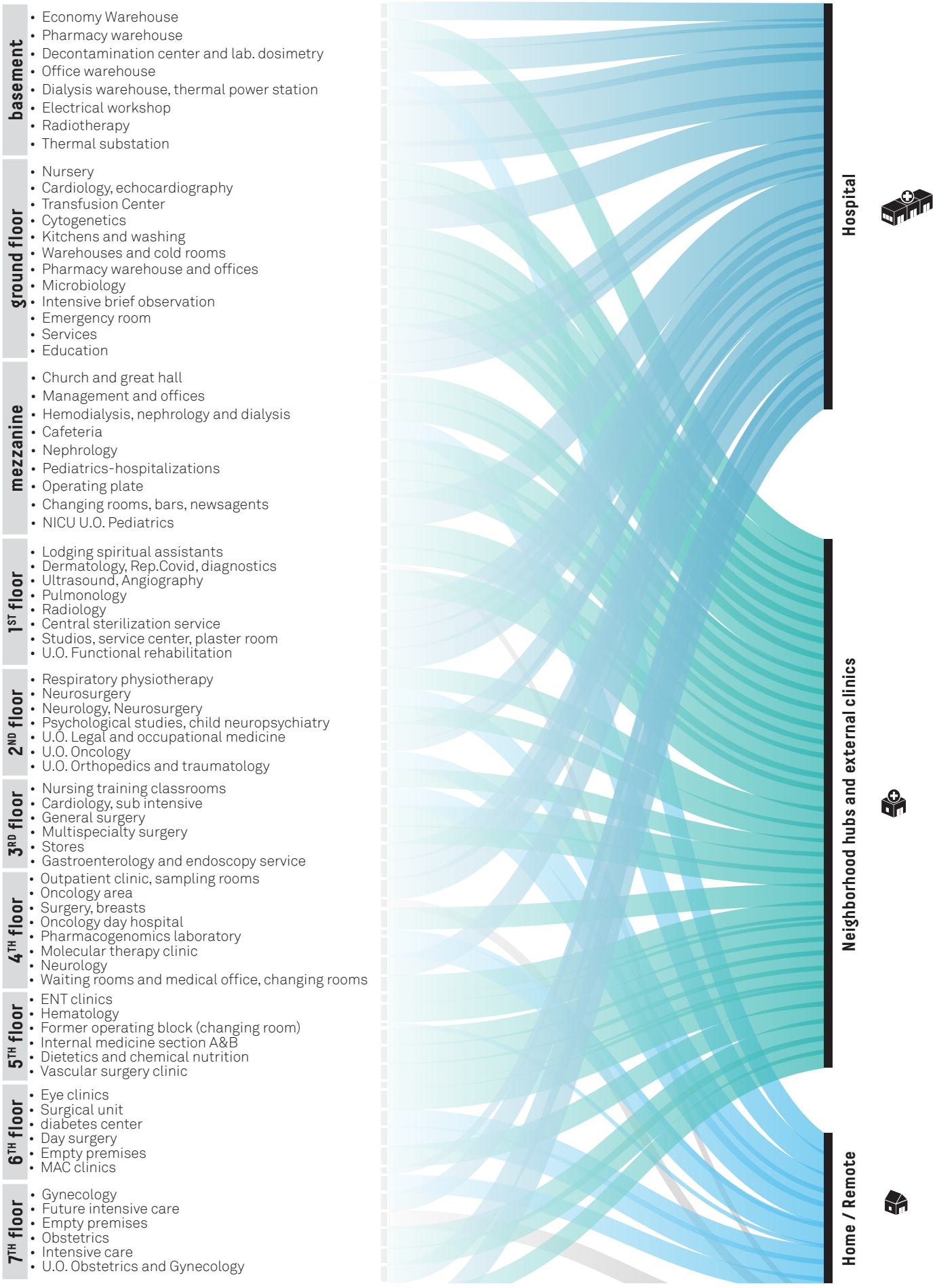


FIG. 8 *Concept diagram: the hospital of the future, a connected ecosystem where many services are delocalized*


basement
• Economy Warehouse
• Pharmacy warehouse
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• Office warehouse
• Dialysis warehouse, thermal power station
• Electrical workshop
• Radiotherapy
• Thermal substation
ground floor
• Nursery
• Cardiology, echocardiography
• Transfusion Center
• Cytogenetics
• Kitchens and washing
• Warehouses and cold rooms
• Pharmacy warehouse and offices
• Microbiology
• Intensive brief observation
• Emergency room
• Services
• Education
mezzanine
• Church and great hall
• Management and offices
• Hemodialysis, nephrology and dialysis
• Cafeteria
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• Operating plate
• Changing rooms, bars, newsagents
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• Lodging spiritual assistants
• Dermatology, Rep.Covid, diagnostics
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• Central sterilization service
• Studios, service center, plaster room
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2ND floor
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• Neurosurgery
• Neurology, Neurosurgery
• Psychological studies, child neuropsychiatry
• U.O. Legal and occupational medicine
• U.O. Oncology
• U.O. Orthopedics and traumatology
3RD floor
• Nursing training classrooms
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• General surgery
• Multispecialty surgery
• Stores
• Gastroenterology and endoscopy service
4TH floor
• Outpatient clinic, sampling rooms
• Oncology area
• Surgery, breasts
• Oncology day hospital
• Pharmacogenomics laboratory
• Molecular therapy clinic
• Neurology
• Waiting rooms and medical office, changing rooms
5TH floor
• ENT clinics
• Hematology
• Former operating block (changing room)
• Internal medicine section A&B
• Dietetics and chemical nutrition
• Vascular surgery clinic
6TH floor
• Eye clinics
• Surgical unit
• diabetes center
• Day surgery
• Empty premises
• MAC clinics
7TH floor
• Gynecology
• Future intensive care
• Empty premises
• Obstetrics
• Intensive care
• U.O. Obstetrics and Gynecology
Hospital
Neighborhood hubs and external clinics
Home / Remote

The hospital becomes a place for the holistic well-being of the patient, in harmony with the entire ecosystem.

Wellness for the ecosystem

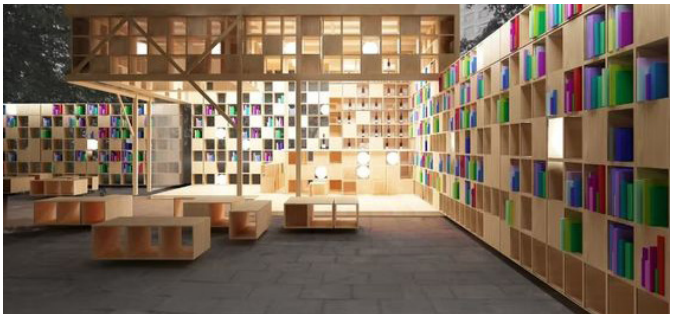
- *The hospital and Health Park integrate services and spaces that promote a healthy lifestyle, with a focus on nutrition, exercise, social interaction, serenity and stress release;*

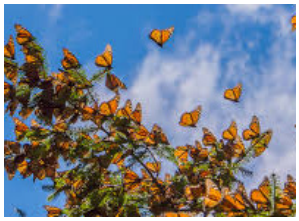
- *The wellbeing of the person involves the entire ecosystem: the hospital becomes a place of harmony between man and nature, also through respect for other species and the inclusion of animals both as companions and as support for therapy in clinical-assistance services that can benefit from their contribution (IAA - Interventi Assistiti con gli Animali).*

Wellness for the ecosystem
harmony between species

Wellness for the ecosystem

New services and integrative spaces are dedicated to the **holistic well-being** of the person, taking into consideration aspects such as nutrition, serenity, social interaction, and exercise. Other spaces and services are dedicated to **promoting harmony between man and the ecosystem**, e.g. through pet-therapy spaces, shared gardens, botanical gardens, greenhouses, orchards, water areas.





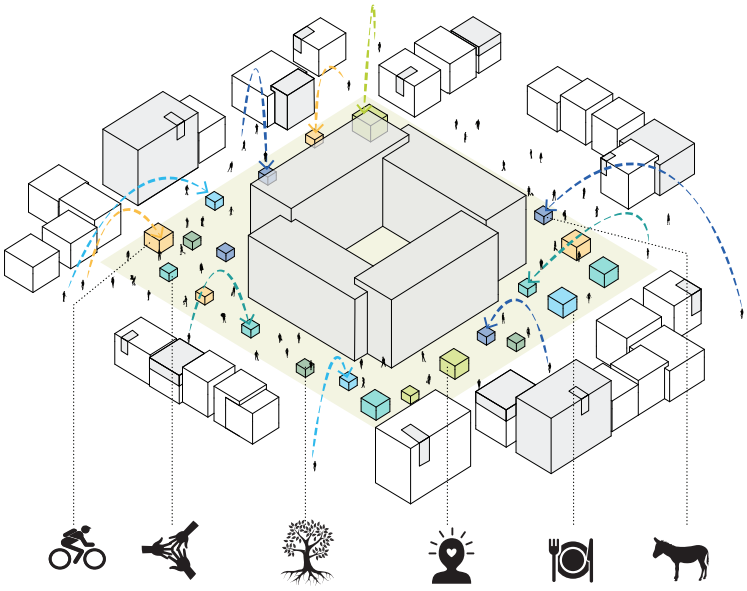
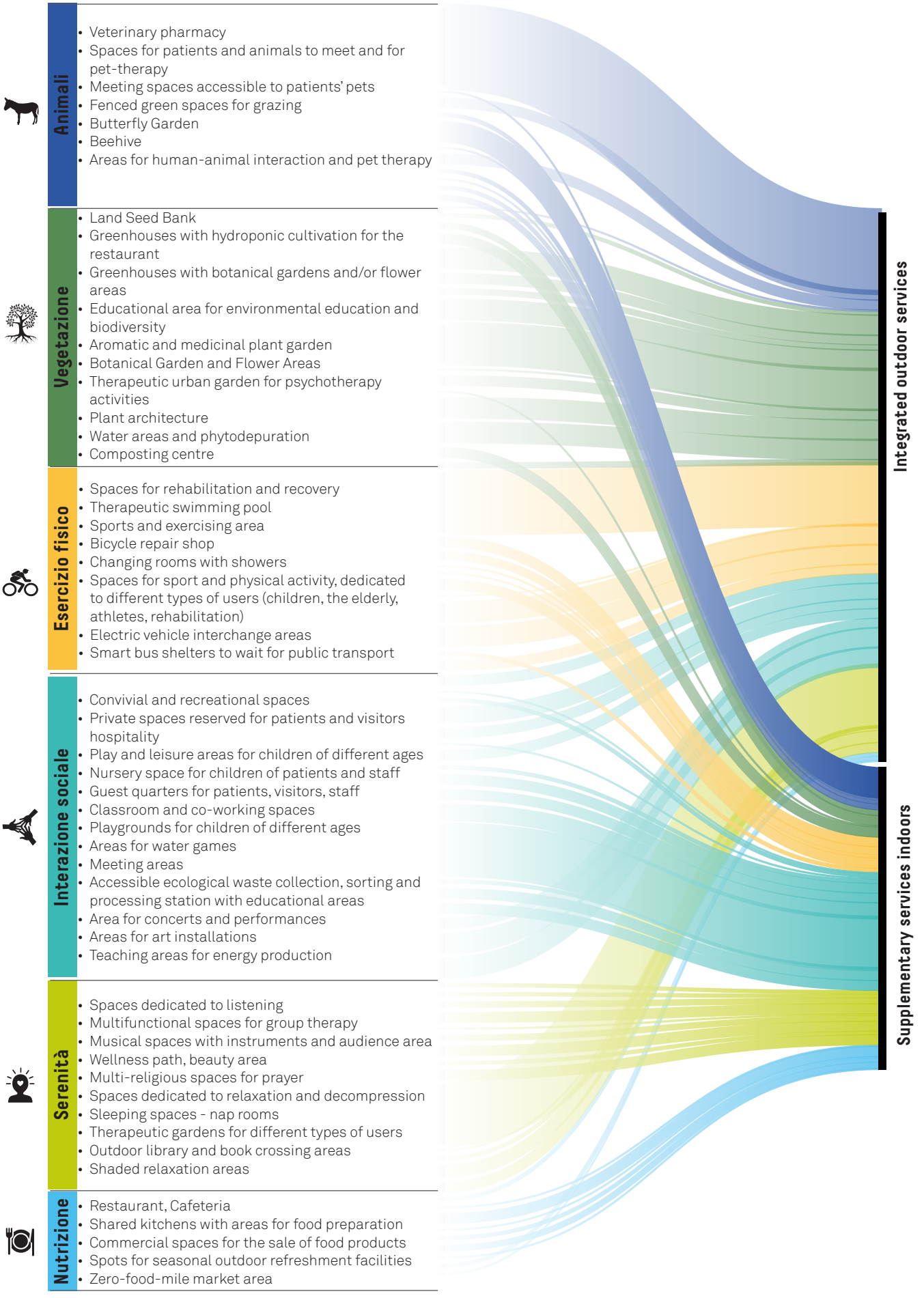


FIG. 9 *Conceptual diagram: the hospital of the future, in which the space freed up by the large hospital structure of the past becomes a container for activities for the preventive well-being of patients, staff and citizens*


Animali
Veterinary pharmacy
Spaces for patients and animals to meet and for pet-therapy
Meeting spaces accessible to patients' pets
Fenced green spaces for grazing
Butterfly Garden
Beehive
Areas for human-animal interaction and pet therapy
Vegetazione
Land Seed Bank
Greenhouses with hydroponic cultivation for the restaurant
Greenhouses with botanical gardens and/or flower areas
Educational area for environmental education and biodiversity
Aromatic and medicinal plant garden
Botanical Garden and Flower Areas
Therapeutic urban garden for psychotherapy activities
Plant architecture
Water areas and phytodepuration
Composting centre
Esercizio fisico
Spaces for rehabilitation and recovery
Therapeutic swimming pool
Sports and exercising area
Bicycle repair shop
Changing rooms with showers
Spaces for sport and physical activity, dedicated to different types of users (children, the elderly, athletes, rehabilitation)
Electric vehicle interchange areas
Smart bus shelters to wait for public transport
Interazione sociale
Convivial and recreational spaces
Private spaces reserved for patients and visitors hospitality
Play and leisure areas for children of different ages
Nursery space for children of patients and staff
Guest quarters for patients, visitors, staff
Classroom and co-working spaces
Playgrounds for children of different ages
Areas for water games
Meeting areas
Accessible ecological waste collection, sorting and processing station with educational areas
Area for concerts and performances
Areas for art installations
Teaching areas for energy production
Serenità
Spaces dedicated to listening
Multifunctional spaces for group therapy
Musical spaces with instruments and audience area
Wellness path, beauty area
Multi-religious spaces for prayer
Spaces dedicated to relaxation and decompression
Sleeping spaces - nap rooms
Therapeutic gardens for different types of users
Outdoor library and book crossing areas
Shaded relaxation areas
Nutrizione
Restaurant, Cafeteria
Shared kitchens with areas for food preparation
Commercial spaces for the sale of food products
Spots for seasonal outdoor refreshment facilities
Zero-food-mile market area
Integrated outdoor services
Supplementary services indoors

The hospital is designed around the patient's care pathway (Patient Journey) to streamline the entire experience inside and outside the hospital.

Patient Journey

- *The project stems from the clinical, social and behavioural needs of the patient, in order to :*
  / ensuring a smooth and efficient experience
  / ensuring the effective integration of digital and physical performances and services
  / offer a customised route;

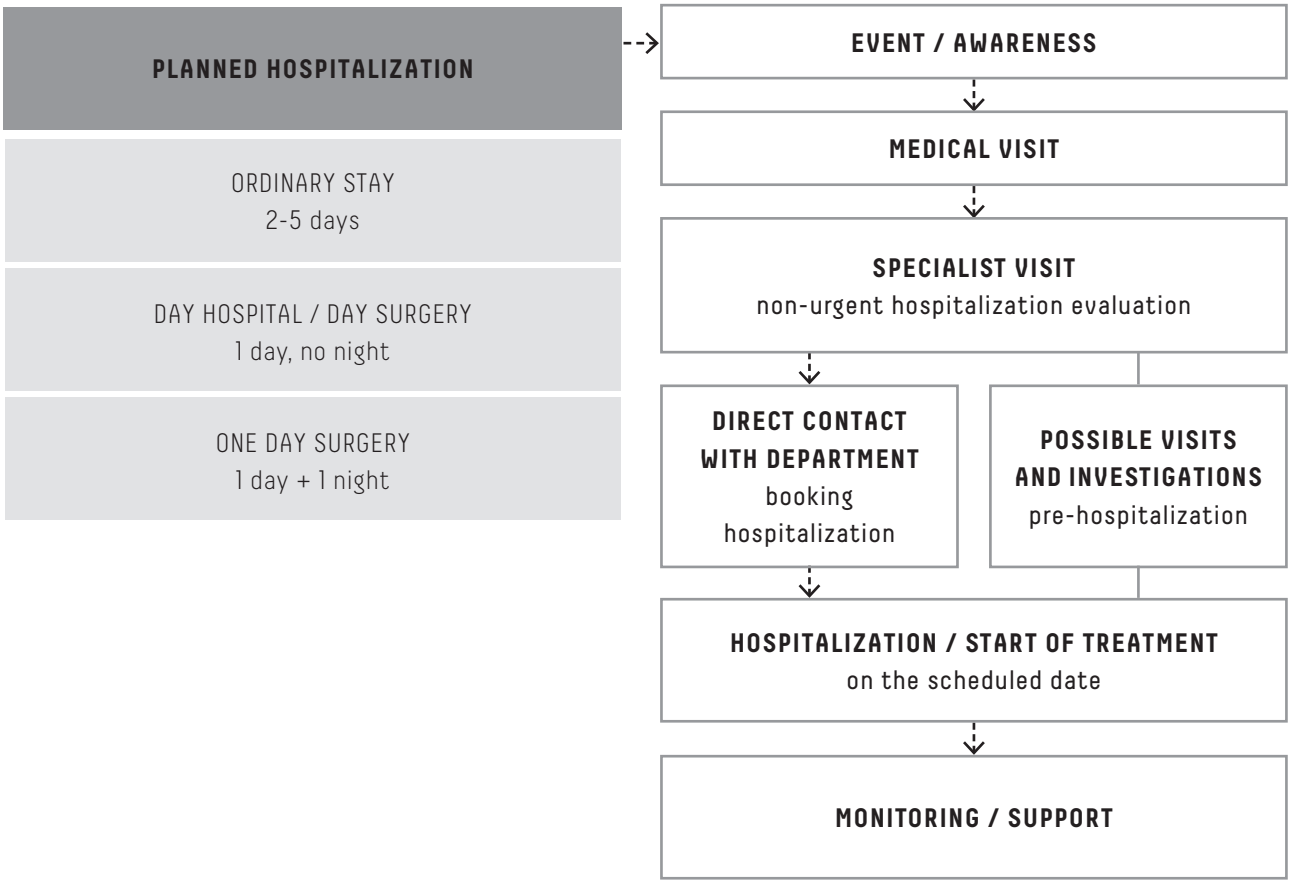
- *Within the hospital, in-patient areas are integrated with areas dedicated to the person: patients do not 'follow' the services they need, instead it is the diverse services, be it clinical or logistic support, that reach him.*

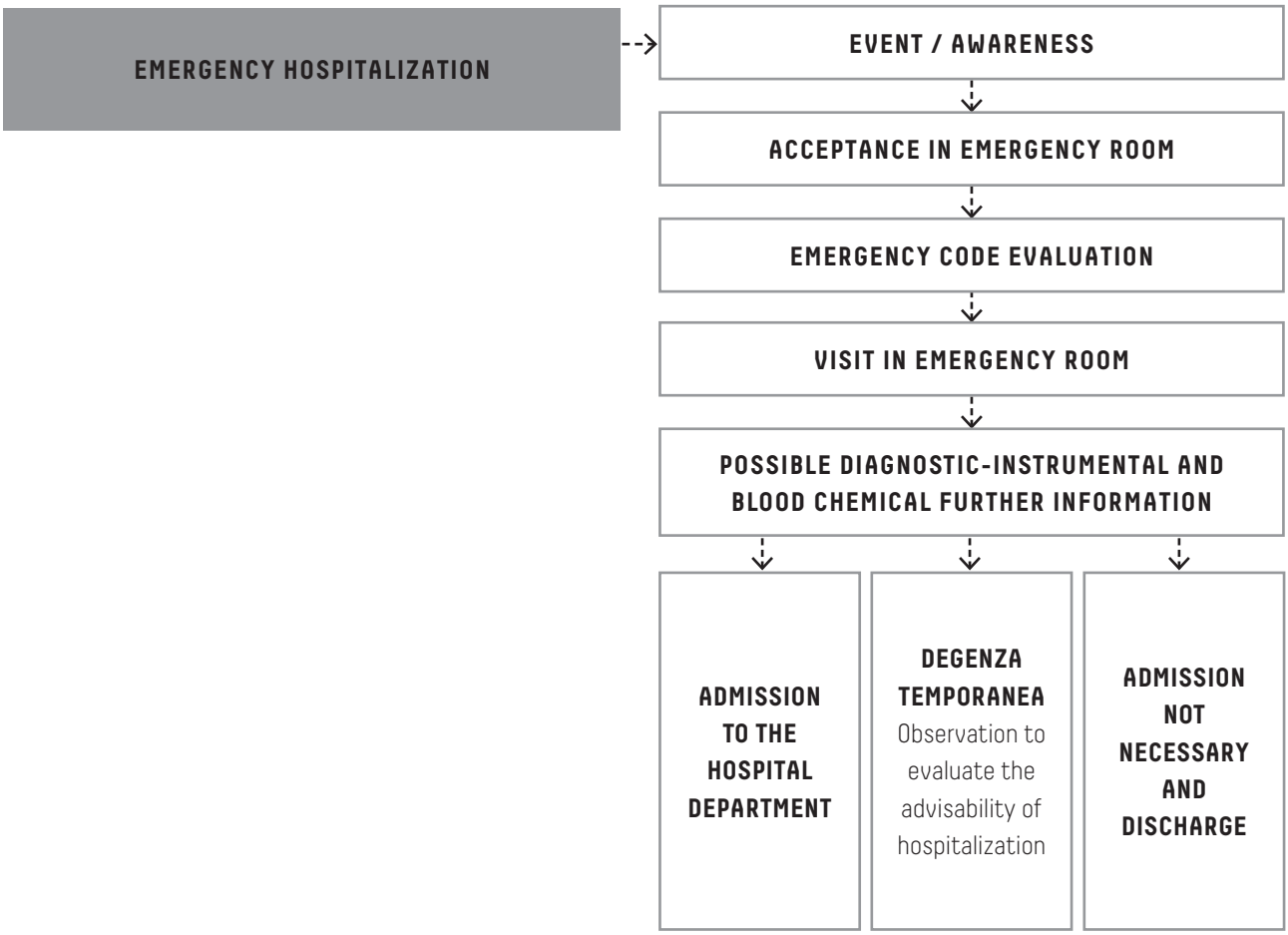
Patient Journey
step by step today

Progettazione con il paziente al centro del progetto

Analysing the **patient experience, throughout the entire care pathway**, provides an opportunity to identify both the weak and strong points of the current healthcare system with the aim of improving each patient's experience in the future.

The analysis of the patient experience pathway can be schematised by describing a **selection of typical patients representative of different patient and experience categories**. Their current pathway is briefly defined by successive stages, from admission by the system to discharge. Subsequently, possible improvements achievable through the implementation of measures such as those proposed in these guidelines are outlined. (see Chapter 4 - Patient Journey)




EMERGENCY HOSPITALIZATION
EVENT / AWARENESS
ACCEPTANCE IN EMERGENCY ROOM
EMERGENCY CODE EVALUATION
VISIT IN EMERGENCY ROOM
POSSIBLE DIAGNOSTIC-INSTRUMENTAL AND BLOOD CHEMICAL FURTHER INFORMATION
ADMISSION TO THE HOSPITAL DEPARTMENT
DEGENZA TEMPORANEA
Observation to evaluate the advisability of hospitalization
ADMISSION NOT NECESSARY AND DISCHARGE

Patient Journey
Personas definition

Analysis of pathologies and causes of hospitalization

MOST FREQUENT CAUSES OF HOSPITALIZATION IN ITALY [2]

TOP 3

1/ Heart failure
2/ COPD (Chronic Obstructive Pulmonary Disease)
3/ Knee arthroscopic operations
4/ Fracture of the neck of the femur

MOST WIDESPREAD DISEASES IN ITALY[3]

TOP 3

1/ Cardiovascular diseases | First cause of death in Italy | men 40-50 years old
2/ Neoplastic diseases | Second cause of death in Italy | women 0-49 years old
3/ Metabolic diseases | worldwide diffusion | men over 65
4/ Respiratory diseases | 3rd cause of death in Italy and 4th in Europe | men 35-64 years old
5/ Rheumatic and osteoarticular diseases | 1 due to pain and disability | women 35+ years old
6/ Diseases of the nervous system | 1st cause of emergency room access | Every age
7/ Dementias | Men and women | over 65
8/ Mental disorders | Men and women | Ages 30 and up

MOST WIDESPREAD CHRONIC DISEASES IN ITALY[4]

TOP 3

1/ Hypertension | Women over 65
2/ Arthritis | Women over 65
3/ Allergic diseases | Women 35-64 years old
4/ Osteoporosis | Women over 65
5/ Diabetes | Men over 50
6/ Chronic bronchitis | Men and women over 65
7/ Nervous disorders | Women over 65
8/ Caridac pathologies | Men over 40
9/ Gastric or duodenal ulcer | Men and women over 35

Selection of categories of users

Personas

HOSPITALIZATION

- Chronic disease users
- Scheduled hospitalization
- Vulnerable users with multiple diseases
- Prolonged experience within the hospital
- Prolonged post-hospital support and monitoring experience

Sandro - Patient 1

- Man;
- 67 years old;
- Suffering from multiple chronic diseases, including cardiovascular disease and diabetes.

DAY HOSPITAL

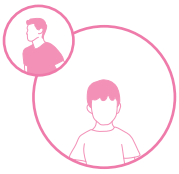
- Users with joint trauma and the need for arthroscopic surgery
- Emergency hospitalization, emergency room access
- Punctual and outpatient experience
- Rehabilitation path and subsequent visits with limited timing

Sofia - Patient 2

- Woman;
- 23 years;
- Generally healthy;
- Fracture of the femur.

PEDIATRICS

- Users with chronic diseases
- Scheduled hospitalization in the pediatric ward
- Prolonged experience within the hospital
- Vulnerable user with need for support and constant presence of the family caregiver



Giulio - Patient 3

- Child;
- 8 years;
- suffering from multiple chronic diseases, including neoplastic and allergic diseases.

The definition of user categories, by way of example only, takes into account the most common pathologies and causes of hospitalisation, in order to represent different modes of interrelation between patient and hospital structure. The definition of specific “Personas” enables a typical Patient Journey to be examined in detail.

The hospital also becomes a place for meeting and social interaction, integrated with the urban and environmental context.

Opening up to the city

- *A range of integrative services and new functions, including non-healthcare functions, find their way into the hospital area, allowing easy interrelation between patients, visitors and staff;*

- *The Health Park is an active place, planned to host outdoor activities for patients, staff and citizens, with different levels of accessibility;*

- *Private and public spaces are differentiated through design solutions that ensure a high level of privacy and security.*

Opening up to the city
gradient between public and private

Architectural opening

The New Hospital and the Health Park integrate non-health services and functions, becoming an **organic part of the city and the region, in which it is located**. The design and architectural strategies must be consistent with the objective and provide solutions to priority issues such as p**ermeability with the context**, the definition of a hierarchy of flows that allow proper use, while respecting the canons of accessibility, security and privacy.

The design of the New Hospital represents an **opportunity to define a proper interaction with the urban context** and will need to convey openness, transparency, sustainability. It will also have to be able to be a coherent expression of the most current trends in contemporary architecture. *Examples of different urban permeability strategies are given below for illustrative purposes only.*

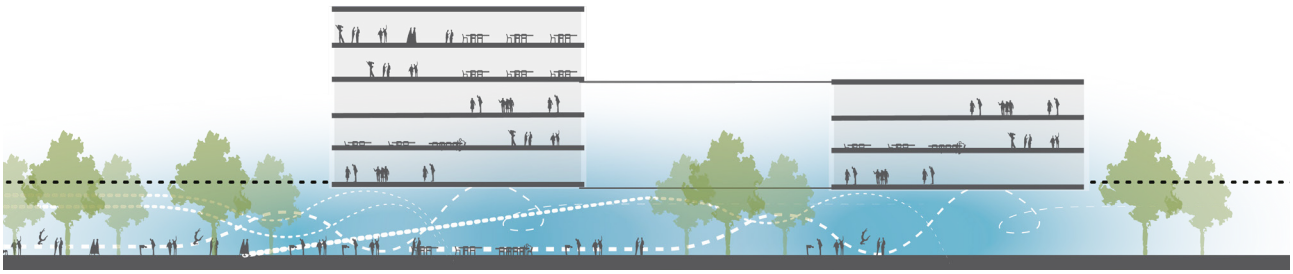
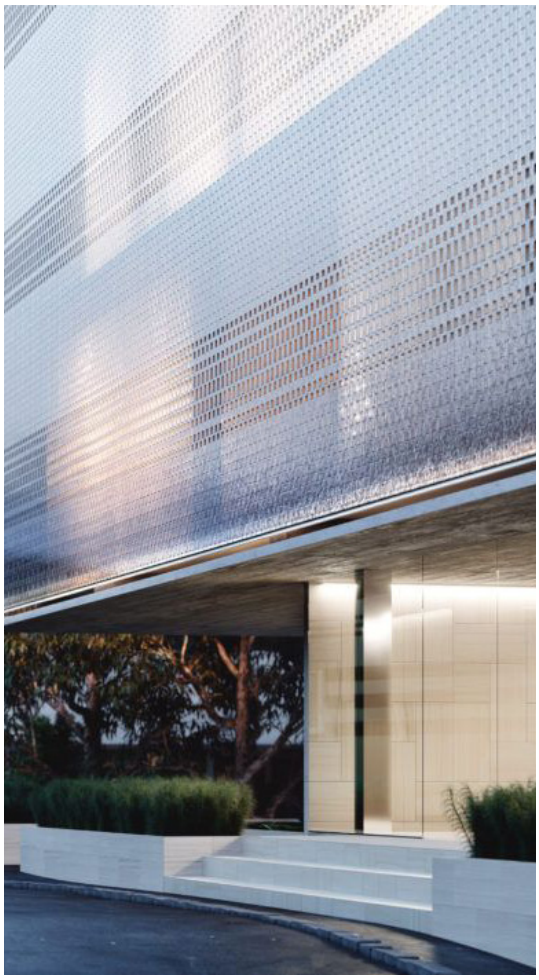


FIG. 10 *Conceptual diagram of opening to the city: public area on the ground floor and private hospital area on the upper floors*



National University Hospital Campus international references

Public space at street level

The new hospital is built on top of the existing building, which remains fully operational. Upon completion, the old hospital will be demolished, **freeing up the ground floor, which will be converted into a public space** open to patients, staff and citizens and full of spaces dedicated to well-being.

SINGAPOR
GENSLER, 2021

Lessons learned:
The public ground floor generates urban permeability, ensuring privacy and security on the upper floors. The continued operation of the existing hospital during the construction of the new one can be achieved through innovative design strategies.

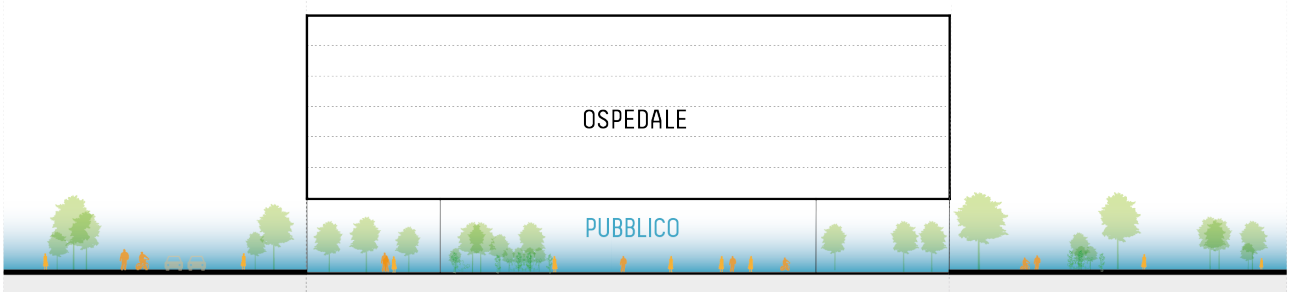


FIG. 11 *Example diagram of opening to the city: public area on the ground floor and private hospital area on the upper floors*

Erasmus MC
international references

Connection central axis

Erasmus is defined as 'a city within the city' with public spaces such as squares, gardens and **avenues with pre-calculated branches, alleys and shortcuts**. The central connecting public axis forms the backbone of the complex and connects the existing buildings with the new ones.

ROTTERDAM, NETHERLANDS
EGM ARCHITECTS, 2018

Lessons learned:
A central, barycentric public space with accessible services converges the public and private spaces, fostering interaction between patients, staff and citizens. Urban permeability can be defined by a smooth transition between the city and the hospital, concentrated on the crossing axes.

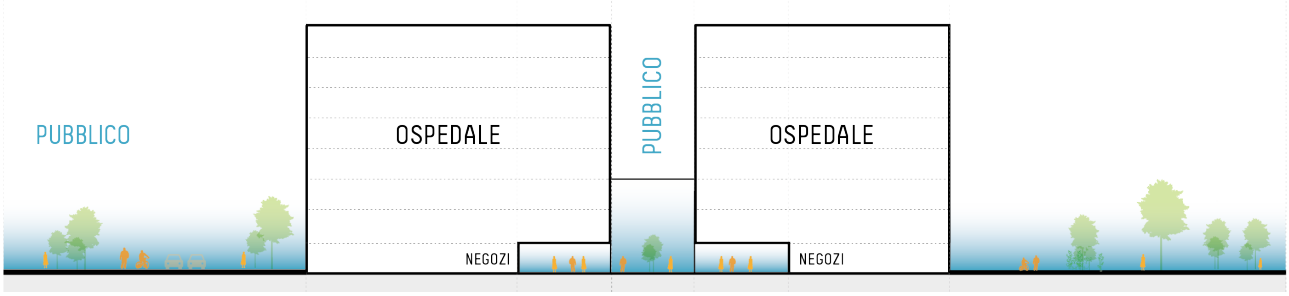
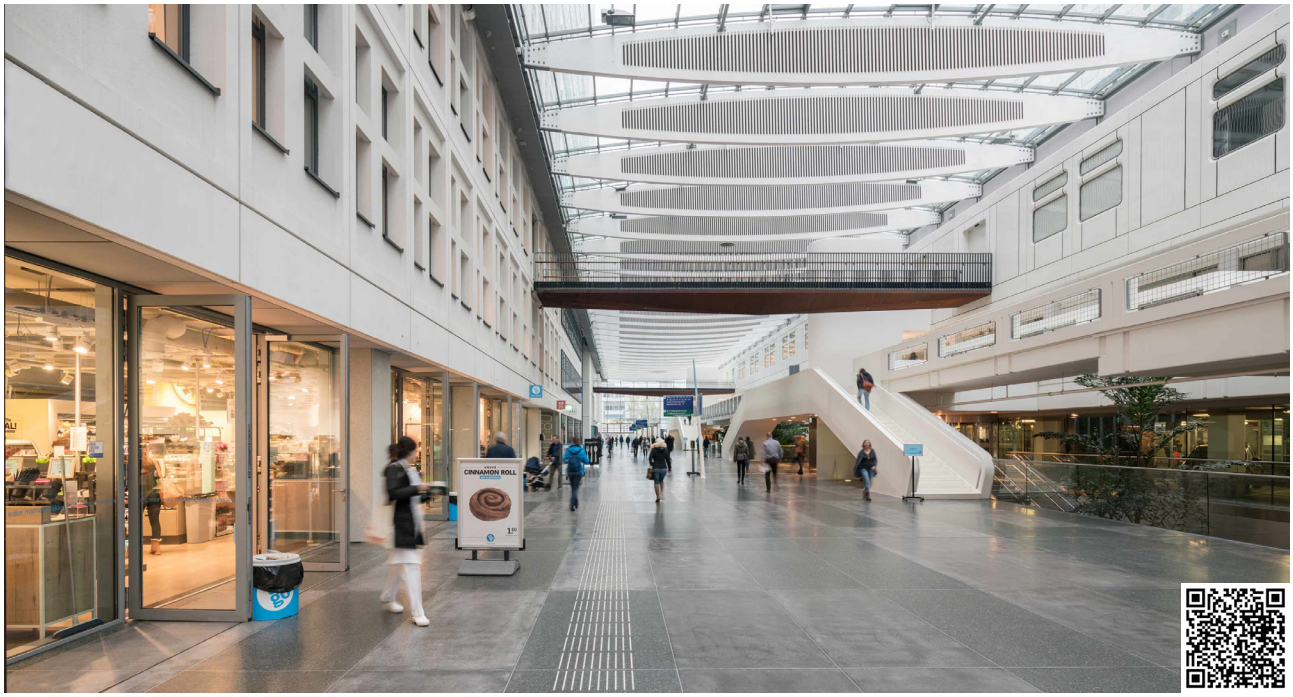


FIG. 12 *Example diagram of opening to the city: central public axis and private hospital area laterally*



The Oriel, Moorfields Eye Hospital
international references

Public Atrium

The focus of the new building is a **full-height public atrium**, from which there is considerable visibility and access to the main departments. The ground floor contains non-medical functions and services to create an active and lively public space, providing services to the city.

CAMDEN, LONDON UK
AECOM, WHITE ARKITEKTEN, 2025

Lessons learned:
Urban permeability can refer to portions of the building, such as the atrium or inner courtyard, which when provided with city amenities generate an active and lively public space. Ensuring visibility of destinations and functions through design, for example through double heights, optimises orientation.

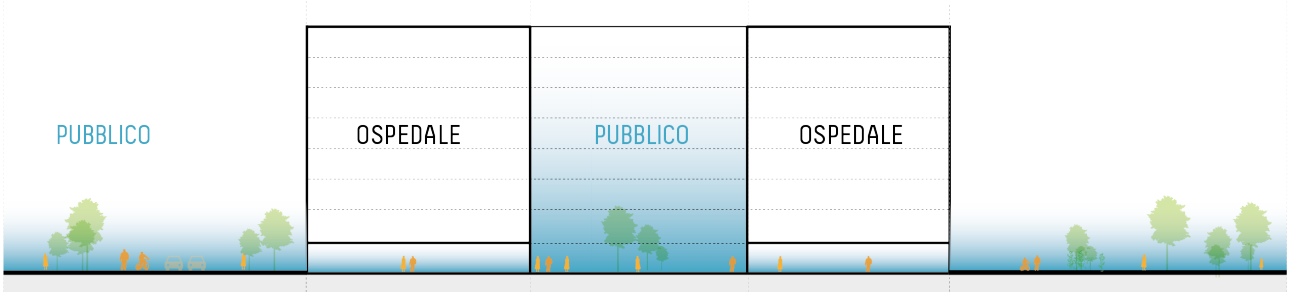


FIG. 13 *Example diagram of opening to the city: central courtyard and public ground floor and surrounding private hospital area*

RWTH University Hospital
international references

Public space on the rooftop

Much of the design of the new building is located below ground level to minimise the visual impact on the existing historic building. The **roof becomes a green park** open to both the public and staff.

AACHEN, GERMANY,
C.F. MOLLER ARCHITECTS IN
COLLABORAZIONE CON HENN, 2017

Lessons learned:
Urban permeability can take place on different levels, in addition to the ground level, generating new public spaces such as terraces and hanging gardens. Creating a green connective tissue with the city ensures the usability and continuity of public spaces and green pathways at street level.

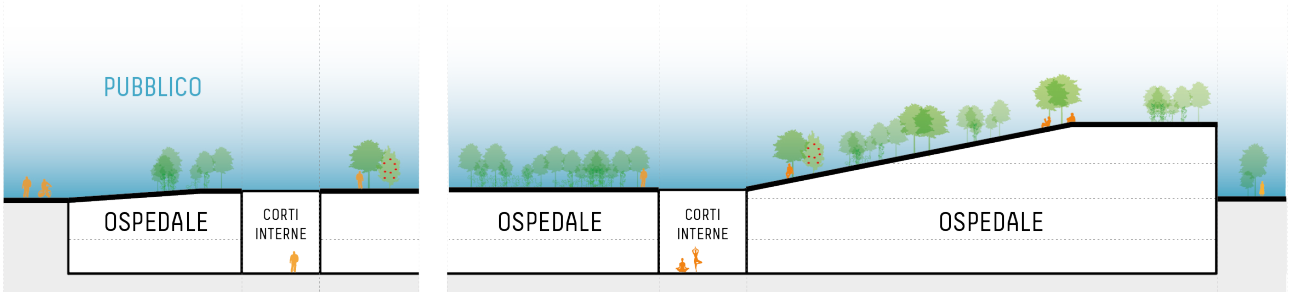


FIG. 14 *Example diagram of opening to the city: public coverage and underlying private hospital area*

Design principles
New Hospital of Cremona

A self-regulating hospital

A hospital where **technology is at the service of efficiency and well-being**. Spaces and services are customised, processes are automated (cleaning, delivery of meals, movement of users, etc.) to allow staff to dedicate themselves exclusively to patient car. **Information is monitored in real time**: data from all infrastructures are collected and monitored via the hospital's '*digital twin*'.

#comfort #personalisation #responsive environment #automation #digital twin #data use and management

A flexible hospital

An adaptable hospital, able to **rapidly modify its structure to respond to changes in context and needs**, thanks to flexible space strategies, modular construction techniques and adaptable plant strategies.

#future proof #flexibility #modularity #digital fabrication #multipurpose spaces

A hospital with optimised flows

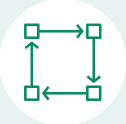
A hospital with **diversified and optimised internal and external routes** for different flows of users (patients, staff, visitors, suppliers) and goods (drugs, food, waste, etc.) A focus on sustainable mobility and the mobility of the future.

#sustainable mobility #flexible parking #future of the ambulance #flux #wayfinding

A welcoming and soothing hospital

A hospital **designed around people, both patients and medical staff.** A hospital with novel space kinds and architectural quality, with regard to materials, forms, and spatial distribution to support holistic well-being.

#patient design #staff design #materials #light #sound #art #architecture #design



An efficient, closed-loop hospital

A sustainable hospital that **aims to reduce its environmental footprint to zero**, is able to monitor, regulate and optimise closed cycles of energy, food, water and waste, promoting the circular economy. It produces energy and potentially strives for self-sufficiency.

#decarbonisation #energy efficiency #renewable energies #circular economy #materials bank #reuse

A hospital open to the city

A hospital that is **integrated into its context, permeable and, with the Health Park** that completes and integrates it, offers a new green lung to the city. It is not only a place of care, but also provides the community with non-health services that constitute a space for relations and interchange between patients, visitors and citizens.

#urban permeability #Health Park #city services

3 Design Guidelines

The New Hospital is inclusive, integrated and permeable to the urban context. It ensures efficient routes and clear directions, while promoting sustainable mobility.

Mobility and flows

Mobility and flows
framework and present conditions

Sustainable mobility
promoting walking and micro-mobility

Parkings
strategic location and flexibility

Accessibility
types of flows and entrances to the area

Orientation
wayfinding design and signage

The New Hospital and Health Park are easily accessible to all types of users. With an emphasis on light and sustainable transportation, accesses and routes are streamlined, adaptable, and open to future improvements.

The New Hospital aims at being a **promoter of sustainable mobility and healthy lifestyle**, through strategies to encourage walking, cycling and adopting electric and shared vehicles. The use of private cars will be discouraged and when required, parking spaces will be adaptable and dynamic for alternative usages. Optimal solutions will be put in place for each user to make access to the new hospital **easy, understandable and inclusive.**

Mobility and flows
framework and present conditions

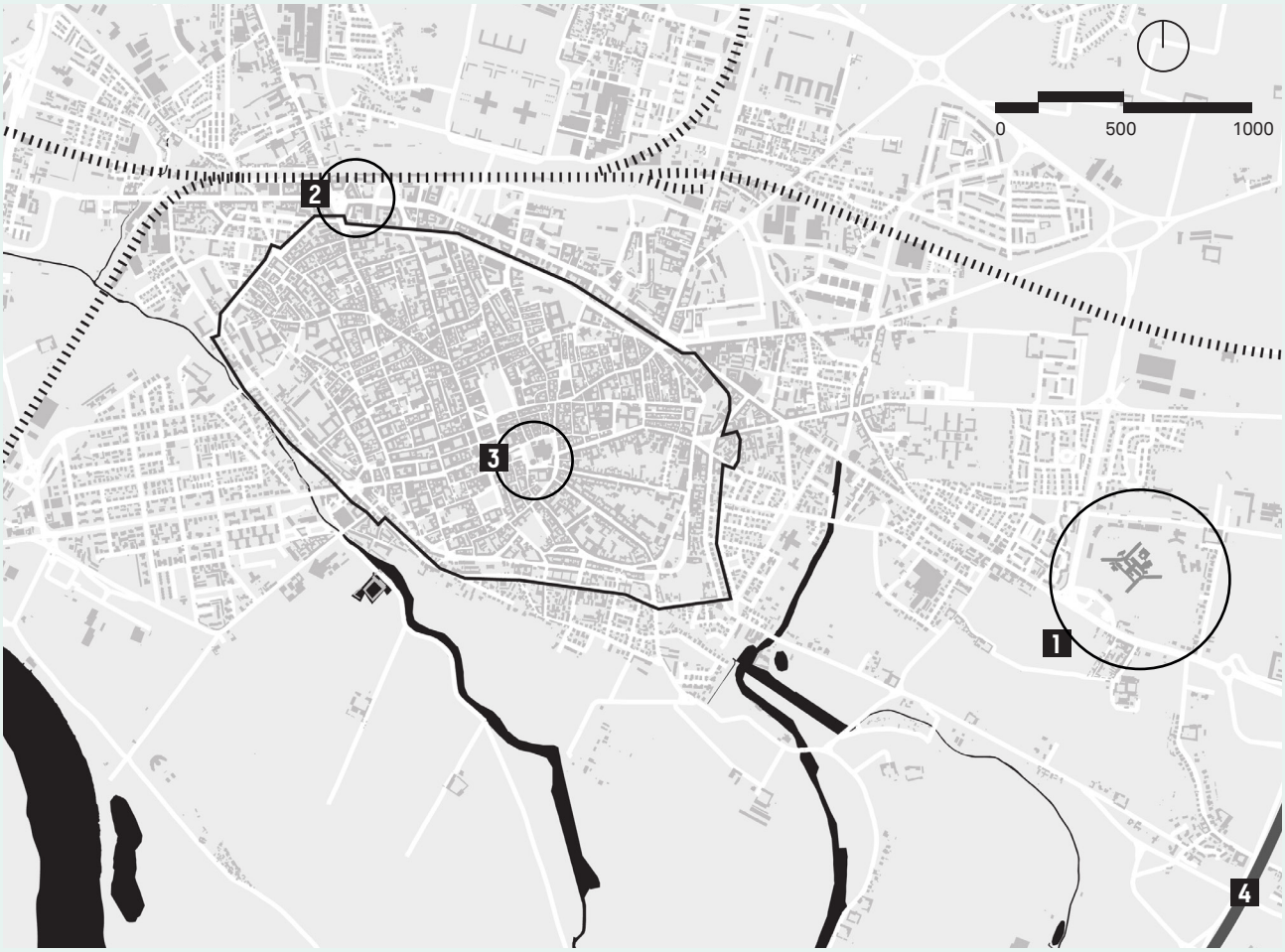
Location of the Cremona Hospital

The **New Hospital will be built southeast of the historic district** within the area of the existing Hospital of Cremona, in an area on the border between the countryside and the city. Its proximity to the A12 Turin-Brescia motorway junction guarantees an ideal connection with the entire region.

The hospital facility features a **medium-high degree of accessibility** (PGT – Land Government Plan, Service Plans), the services are accessible from the urban area with a 10-minute walk distance.

The distance from Cremona Central Station is about 3.5 km and from the centre (indicatively identified in the Cathedral of Santa Maria Assunta) about 2.5 km. Surface public transport consists of a network of trams and buses **connecting Cremona Hospital with the centre** (in approximately 10 minutes) and with the Central Station (in approximately 15 minutes). The involved lines have a number of stops located close to the main entrance of the hospital area.

FIG. 15 *Accessibility to the hospital area from the center of Cremona and from the highway*



1 **Hospital of Cremona** project site
2 Central Station of Cremona
3 Cathedral of Santa Maria Assunta
4 A12 Highway

Sustainable mobility
promoting walking and micro-mobility

Route network and interchange hub

The New Hospital aspires to be a promoter of sustainable mobility and a healthy lifestyle, through **strategies that encourage the use of public transport, electric and shared vehicles, cycling and walking**. Sustainable mobility choices must be convenient and easy for different types of users, also through the inclusion of different-size **transport interchange hubs.**

Transport interchange hubs may include: public transport stops, electric vehicle charging points, convenient parking spaces, short-stay and kiss-and-ride areas, parking for bicycles (including tandems, tricycles and hand bikes), repair areas, totems for information and service booking, telephone charging stations, PV bike shelters, etc.

Strategies for promoting pedestrian and bicycle mobility should be defined, with a focus on **ensuring universal accessibility**, safety of vulnerable users and integration of public transport services and shared and private micro-mobility.

Guidelines

- Promotion of sustainable mobility through the installation of different-sized **transport interchange hubs** and electric vehicle charging points;
- **Strategic location** of the transport interchange hubs within the Park and the new hospital facility;
- **Promotion of cycling**, by providing protected and reserved parking spaces and facilities, such as repair areas, changing rooms, showers, lockers;
- Identification of the access points to the area in **continuity with the external connections** (existing urban routes and public transport stops) and with the new connections within the park (enhanced routes to reach the different destinations of the new hospital facility);
- Connecting the new pedestrian and bicycle paths inside the Health Park with the **access points to the area**;
- Enhancement of **pedestrian and bicycle paths** within the area;
- Promoting the use of **innovative mobility solutions** and electric transport for the internal movement of commodities.

FUTURE MOBILITY HUBS, UK
ARUP+GO-AHEAD
The future of mobility is based on the definition of new public, sustainable and shared transport networks. Different types of Mobility Hubs offer services and spaces for gatherings and social activities.

Lesson learned:
Mobility Hubs are not only places for transport exchange, but become spaces for the community.

Parkings
strategic location and flexibility

Adaptable parking spaces

The New Hospital aims to promote sustainable mobility and limit the use of private cars. In the future, the **number of parking spaces** will hopefully decrease. The surplus parking spaces will be used for other functions. In this light, it is essential that the design of parking spaces, preferably, below ground or above ground, be **flexible and adaptable to future usage**.

In order to promote shared mobility, large and easy kiss-and-ride areas must be created. The park and buildings will only have a **limited view** of the parking lots. Parking spaces should be separated into reserved and reservable places and l**ocated strategically** in relation to the entrances of both the Park and buildings, in order to optimize the various flows.

Guidelines

- Strategic location of car parks to **minimize the extension of driveways** within the area:
- Strategic location of car parks to define flows, **streamline routes and minimize distances**;
- Design of the surface area for car parking to **meet present needs** while being flexible enough to **accommodate a future** with fewer parking places needed;
- **Flexible design** of parking lots so that different functions can be accommodated, if necessary;
- Differentiation of parking spaces into reserved and reservable spaces and for **different means of transport and users** with specific needs;
- **Limited view** of parking spaces.
- Identification of areas for **short-term parking and kiss-and-ride**;

1111 LINCOLN ROAD, MIAMI
HERZOG & DE MEURON
A multi-storey, multi-use car park designed for flexibility, which fits as a landmark in its context, for its architectural quality and the innovation of its spaces. From the outset it is designed as a car park for dynamic use, to provide for more than simply parking places when the car park is not in use and to facilitate other activities.
Lesson learned:
Flexibility is taken into account from the early design stages for current and future uses, so as to maximize the value of the facility for its users.

Accessibility
types of flows and entrances to the area

Enhanced routes from outside to inside

The New Hospital will be crossed by **different types of flows**, dictated by different users, both existing and future. While defining flows and functional distribution, the users to be taken into account are mainly: patients with emergency access and users with autonomous access (patients, visitors and caregivers, medical and non-medical staff, users of the Health Park and non-medical services, delivery logistics and goods collection).

Each flow shall be directed to a **defined, comprehensible, intuitive and clearly signposted route**, which shall be the shortest and most direct route to the destination. Accesses should be efficiently connected with existing urban axes to ensure smooth traffic flow.

The path to the hospital for patients with emergency access should be **prioritised, streamlined, and obstacle-free**. Currently, these patients arrive at the hospital via ambulance, helicopter, or private car. Users with autonomous access currently go to the hospital by public transport, shared electric vehicles private car or taxi, bicycle, on foot or wheelchair. **Vehicular mobility will be kept to a minimum**, and strategies will be carried out to reduce the visibility of driveways from the park and buildings. Future kinds of mobility for all sorts of flow, both autonomous and emergency, will require flow and access design to be adaptable and open.

Guidelines

- **Differentiation of access** to the area and buildings according to different users and their specific needs;
- Design of routes to ensure **maximum efficiency and minimum distance** for each type of flow;
- Design of routes to secure that **all users can utilize** them in a variety of climatic situations;
- **Prioritization and optimization** of emergency flows;
- **Limitation of vehicular mobility** and view of driveways;
- **Flexible route design** to accommodate future forms of mobility.

Orientation
wayfinding design and signage

Universal accessibility

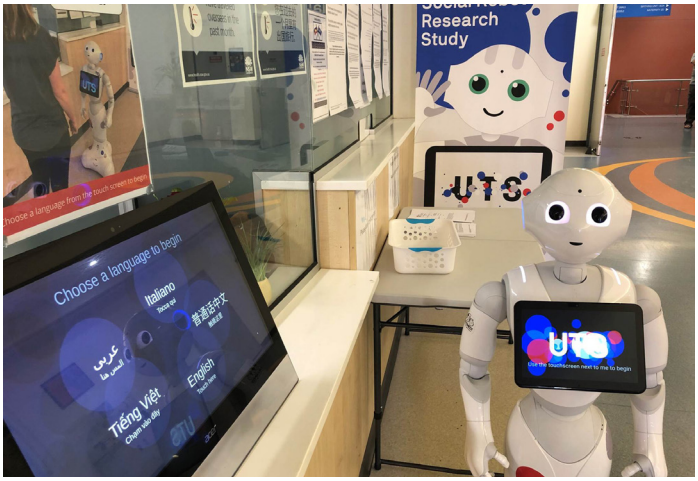
Interior and exterior spaces must be designed with respect to **visibility and recognizability of main functions and destinations**, to ensure comprehensibility and ease of reading of the space.

The distribution of functions must be **logical and easy and intuitive** to understand, and the architectural elements must help to **facilitate user orientation**. Orientation within the New Hospital must be clear and assisted along all routes, both through a linear and comprehensible design of the spaces, and through universal and continuous signage.

The **wayfinding strategy** must be designed seamlessly between outdoor and indoor spaces: the route must be able to easily lead the different users from the access to the Health Park to the interior of the buildings and individual rooms. The signage should be **universal and inclusive**, open to innovative solutions and integrating physical and digital strategies.

Guidelines

- Development of a **rational and intuitive distribution** to the main functions;
- Provision of **architectural elements** (colours, volumes, materials) and **spatial landmarks** to facilitate orientation;
- Implementation of an orientation and **wayfinding strategy** dedicated to different types of flows and mobility (road, bicycle, pedestrian, etc.);
- Design of **universal and inclusive** signage, accessible and understandable to different types of users, considering for example different types of language (foreign languages, blind or deaf people, etc.) and physical needs (height of information suitable for wheelchair users, children, elderly people, etc.);
- Use of integrated signage **between the external and internal spaces** of the New Hospital;
- Implementation of an integrated wayfinding **strategy between physical and digital**, through e.g. interactive navigators (totems, screens, projections, robots, etc.), customised information, multi-channel digital applications, etc.



FAIRFIELD HOSPITAL, SYDNEY

The small robot welcomes patients and visitors at the entrance; it speaks five languages, displays digital maps or videos, and gives verbal and gestural directions. Social behaviours, such as turning and pointing, help people better understand information.

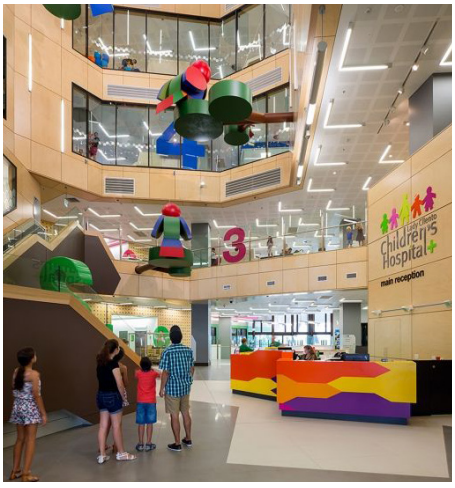
Lesson learned:

An interactive orientation system provides personalized information to users, minimizing time and freeing up staff at the hospital entrance.

SENSE OF COMPREHENSIBILITY[5]

One of the essential elements in the notion of "**salutogenic design**," is comprehensibility and it refers to the capacity to understand one's surroundings and see them as orderly, clear, and organized.

Design may make a space more understandable, for instance, by emphasizing more intuitive routes or by using orientation systems (including colours, landmarks, natural light and views of nature, etc.)

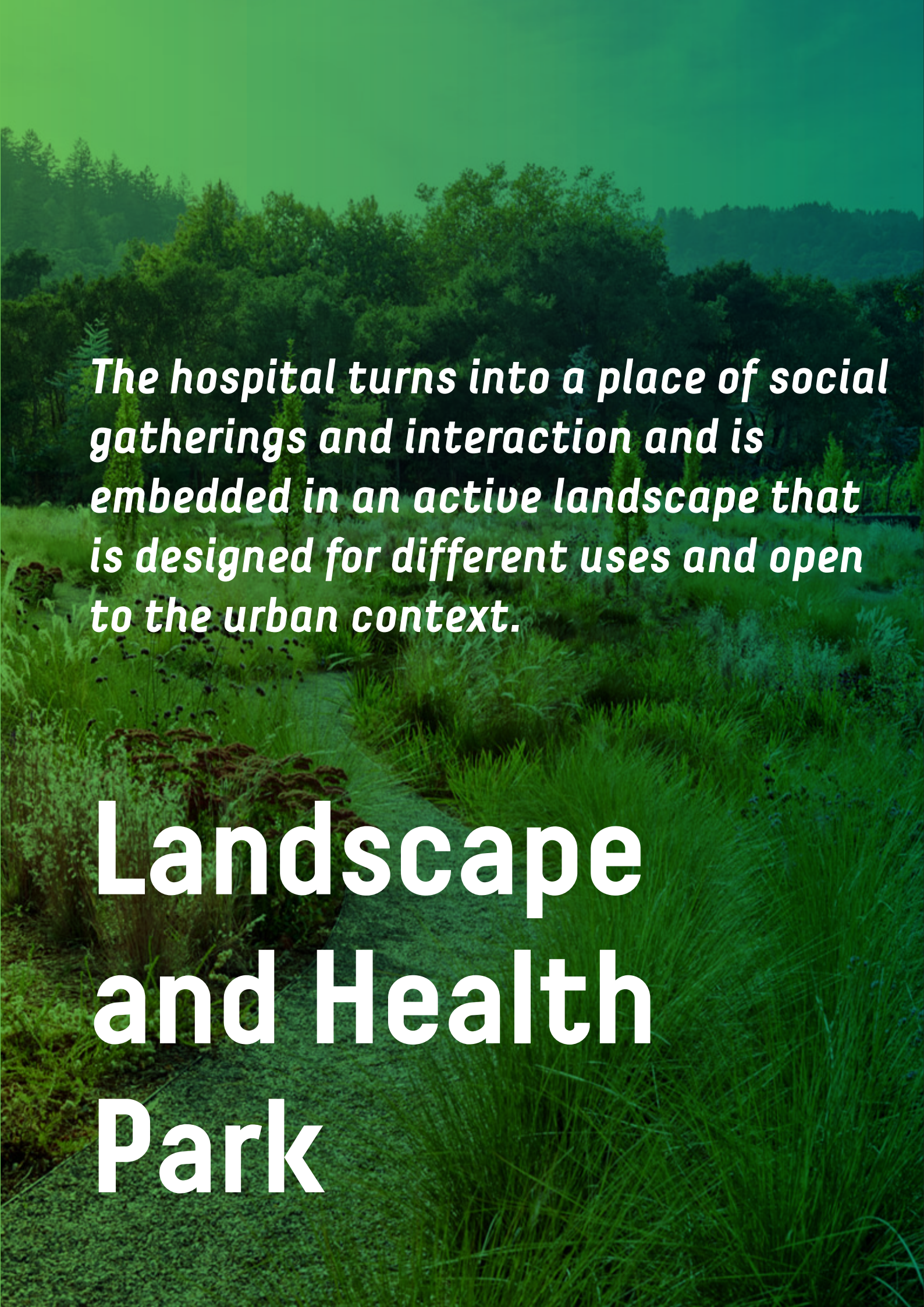


LADY CILENTO CHILDREN'S HOSPITAL, BRISBANE, AUSTRALIA

Architecture and wayfinding work together from the very beginning of the project, creating an integrated orientation system that includes volumes, distribution spaces, materials, colours and environmental graphics that add a sense of joy and vibrancy to the hospital.

Lesson learned:

The orientation system is an integral part of the design and is composed not only of signage, but also of distribution strategies and architectural elements.



The hospital turns into a place of social gatherings and interaction and is embedded in an active landscape that is designed for different uses and open to the urban context.

Landscape and Health Park

The Hospital area
framework and context

Urban permeability
openness and connection

Integrative services
open to the city

Active landscape
park programming

Biodiversity
conservation and acceleration

Green management
and maintenance

The new Health Park will be home to new health and non-health functions, open to citizens, appealing and champion for the principles of ecosystemic well-being.

The New Hospital and the Health Park will function as a **catalyzing pole for the city of Cremona** and the wider catchment area of the Hospital, both thanks to a high-quality healthcare offer, and through the integration of a series of additional services, aimed at involving the population in the dissemination of the principles of wellness, health and the promotion of a healthy lifestyle.

The Park is destined to become the **test-bed for a new concept of wellbeing** and care of the human sphere in relationship with the whole ecosystem. The park will integrate with the environmental context of the **contiguous natural area**, emphasizing and protecting existing natural systems and local biodiversity. It will exploit **green management and control systems** based on Artificial Intelligence (AI), Internet of Things (IoT) and sensitive, automated devices.

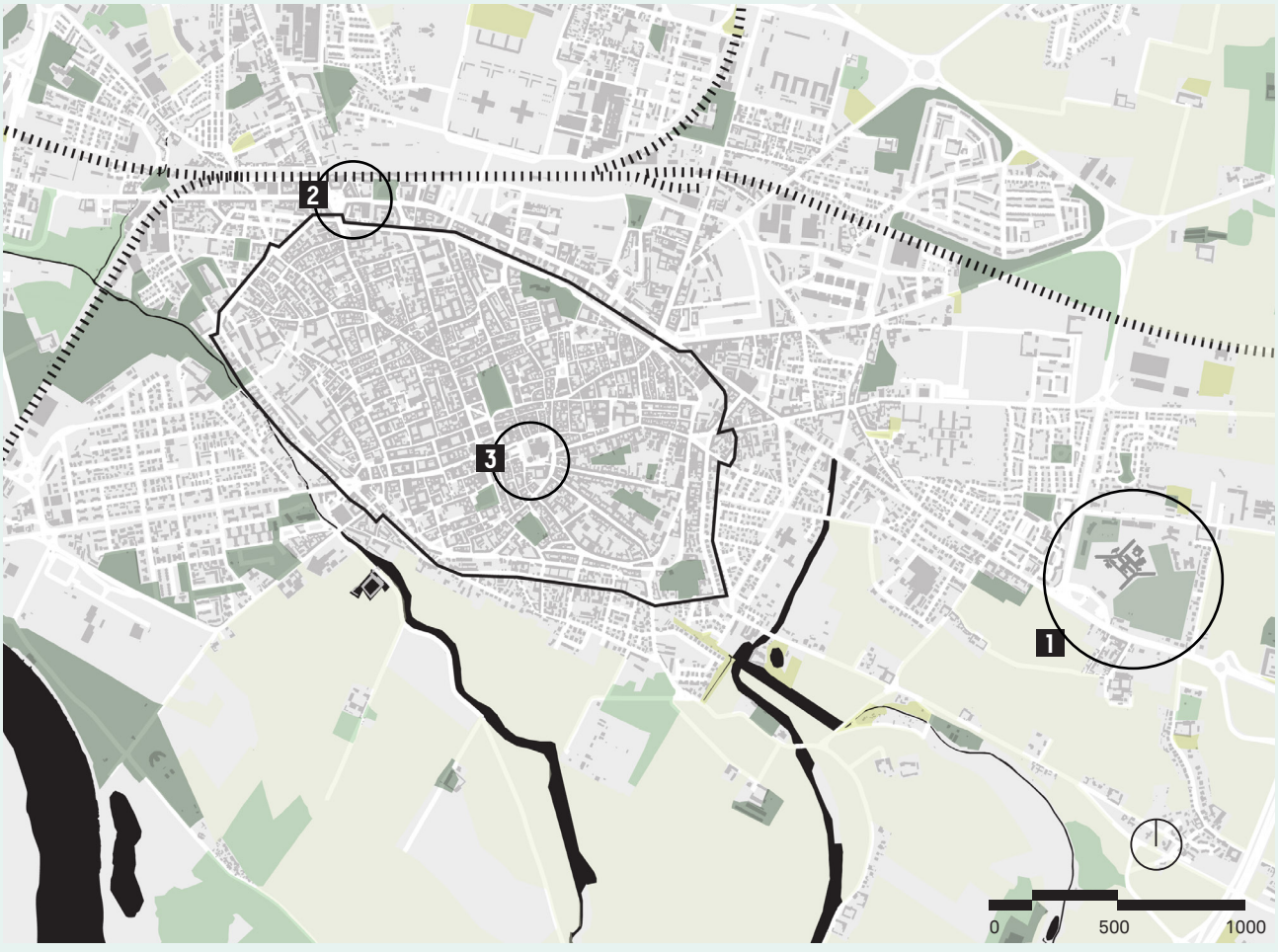
Within the park, mobility and routes will be clearly identifiable and practicable for all types of users, with a focus on user safety and the separation of public and restricted access. The definition of habitats with therapeutic, productive, naturalistic, educational, social, and psychophysical wellness implications will be possible thanks to the **planning of new paved and green areas**.

The Hospital area
framework and context

Context and environmental system

The geographical context in which the Cremona Hospital Centre is situated is **central to two environmental systems**: the Irrigation Plain and the Po and Great Rivers system. In addition to the natural systems, there is a dense artificial hydrographic network, consisting of canals and watercourses, and a large presence of countryside and green areas used for cultivation. The protection of the distinctive characters of the land of interest for the transformation of the hospital facility area is the Parco Locale (PLIS) – the Local Park of Supra-municipal Interest (PLIS) of the Po and Morbasco - whose territorial scope, however, ends south of Provincial Road No. 87, which borders the hospital area. The vast portion corresponding to the appurtenant area to the east of the hospital building is included by Cremona's Land Government Plan comprised in the "Ecological Network", as "elements and passageway of the municipal ecological network". Outside the hospital area, the urban bailiwick classifies the area among park areas, meadow, woodland and arable areas. A part of the hospital grounds amounting to approximately 85,000 square metres is classified among the area as garden, which require transformative interventions to confirm the **naturalistic-environmental values**.

FIG. 16 *System of green areas (web data)*



Urban permeability
openness and connection

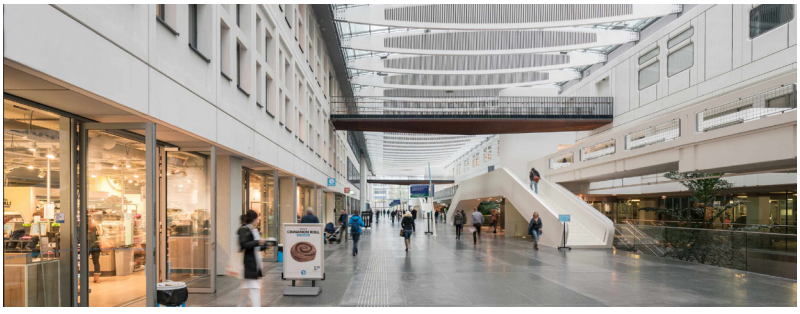
Connected, permeable, accessible and public hospital

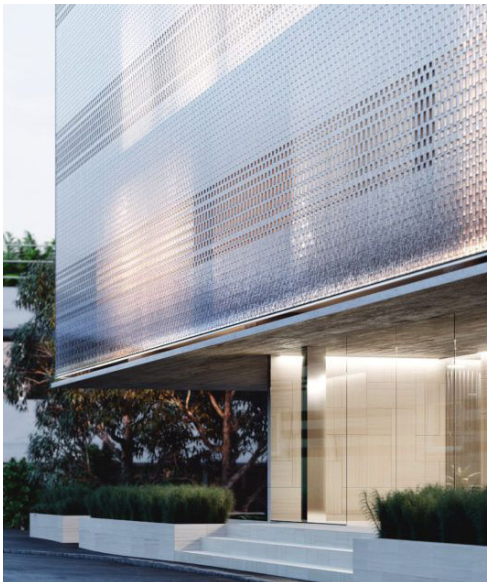
The Health Park will be the **first point of access and interaction** with the New Hospital integrated and permeable to the urban context. The fusion of public and restricted areas will increasingly take place on multiple levels, from the vehicular level and light mobility, to the internal spaces of the hospital building and the Health Park, through the mediation of new functions for the community.

There will be **no physical or visual barriers** for access and connection paths to the hospital; entrances and paths will have to guarantee simple, intuitive and inclusive orientation for all categories of users. **Different degrees of privacy** will be guaranteed for the modulated passage among public and restricted areas. To this end, the application of **innovative strategies and systems for access control** and separation of routes and spaces is favoured.

Guidelines

- A layout guaranteeing both **physical and visual permeability**;
- Creation of **safe and inclusive connection spaces** for all age groups and conditions;
- Integration of **non-health services** for the welfare of patients, staff, visitors;
- Design of a **park open to the city,** physical barriers removed and public spaces clearly defined.
- Distinction of **indoor and outdoor areas for the public and hospital users**, providing security and varying degrees of privacy;
- Innovative **access control strategies** and systems.





Integrative services
open to the city

The New Hospital as a place for gathering and socializing

The new intervention is envisaged as a **HUB of innovative services,** related to the main activities of wellness, education. The New Hospital, as well as, aiming to pursue health, also to **raise awareness of prevention** and **increase awareness in a healthy lifestyle,** for people in harmony with the environment.

To this effect, some new functions to insert within the hospital area are aimed at **promoting the holistic and ecosystemic wellbeing**, with attention to a balanced relationship between humans and their ecosystem. **Integrative services and new non-healthcare functions** will be located within the area, providing opportunities for meeting and exchange between patients, visitors and staff.

Guideliines

- Creation of spaces and services for **psycho-physical well-being**;
- Inclusion of spaces and services to promote **meeting and interaction** between patients, staff, citizens and visitors;
- Creation of spaces and services for the **recreational and motor activity**;
- Establishment of spaces, facilities and modalities, the **use of green areas** as the compound's organic and crucial element;
- Inclusion of spaces and services dedicated to animals employed in **supporting clinical processes (pet therapy)**.

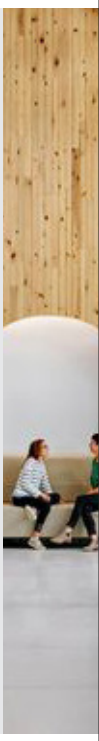
Note: *The functions proposed in the following tables, and relevant sizing, are to be understood as indicative only. Designers may modify or implement new functions. Complementary functions will not be included in the initial investment budgets but can be carried out through the use of the institutions of the Public Contracts Code, with access also to public-private partnership instruments and initiatives.*

Nutrition

- **Restaurant**
- **Cafeteria**
- **Shared kitchens** with areas for food preparation and convivial spaces dedicated to meal consumption
- **Commercial spaces** for the sale of food products and for donations and exchange (food bank)

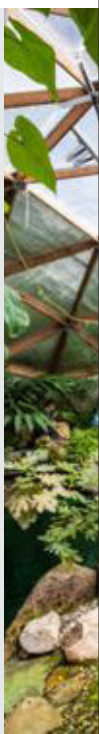
Social interaction

- **Convivial and recreational** spaces
- **Private spaces** reserved for patients and visitors hospitality
- **Play and leisure** areas for children of different ages
- **Supervised nursery** space for children of patients and staff
- **Guest quarters** for patients, visitors, staff (50 pp approx.)
- **Commercial spaces** (shops and local shops)
- **Classroom and co-working** spaces for patients and staff



Vegetation

- **Land Seed Bank**
- **Greenhouses with hydroponic** cultivation for the restaurant
- **Greenhouses with botanical** gardens and/or flower areas
- **Educational area** for environmental education and biodiversity



Serenity

- **Private, intimate spaces** for reflection and meditation
- **Spaces dedicated to listening** and psychological support
- **Multifunctional spaces** for group therapy and courses
- **Musical spaces** with instruments and audience area
- **Wellness path**, beauty area, spa and hairdressing salon
- **Multi-religious spaces** for prayer
- **Spaces dedicated to relaxation** and decompression
- **Sleeping spaces** - nap rooms

Exercise

- **Spaces for rehabilitation** and recovery
- Therapeutic **swimming pool**
- **Sports and exercising** area
- **Bicycle** repair shop

Animals

- **Veterinary pharmacy**
- **Spaces for patients and animals** to meet and for pet-therapy
- Meeting spaces accessible to **patients' pets**

Active landscape
park programming

The Health Park as a destination for community well-being

The Health Park will be an open, lively place, planned to host **different outdoor activities**, usable not only by patients, but by all citizens, with different levels of accessibility. Most of the activities in the Park will be open to the community, and related to the **holistic wellness and care path** promoted by the New Hospital. Within the Park there will be various sports activities, therapeutic paths in the green areas, activities with pets; sociability, refreshments, educational and training spaces are envisaged. All activities shall be **universally accessible** to all types of users. Restricted areas and public spaces will be separated through design solutions that will ensure a **high level of privacy and security**.

Guidelines

- Promotion of outdoor spaces and activities aimed at raising awareness of **nutrition and healthy eating;**
- Creation of outdoor spaces and activities for the **physical and psychological well-being** and serenity of staff and patients;
- Inclusion of outdoor spaces and activities to **encourage social exchange and interaction** between patients, staff, citizens and visitors;
- Creation of outdoor spaces and activities for conducting and promoting **recreational activities** for different types of users;
- **Environmental landscape design** of the divers green areas according to biodiversity criteria;
- Identification of outdoor wellbeing spaces and **activities for pets** and interaction between species.

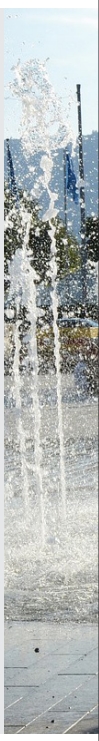
Note: *The functions proposed in the following tables, and relevant sizing, are to be understood as indicative only. Designers may modify or implement new functions.*

Nutrition

- **Spots** for seasonal outdoor refreshment facilities
- **Zero-food-mile market** area
- **Picnic areas** among the trees

Social interaction

- **Playgrounds** for children of different ages and team games
- **Areas for water games**
- **Meeting areas**
- Accessible **ecological waste collection**, sorting and processing station with educational areas
- **Area for concerts** and performances
- **Areas for art installations**
- **Teaching areas** for energy production



Vegetation

- **Aromatic and medicinal** plant garden
- **Botanical Garden** and Flower Areas
- **Therapeutic urban garden** for psychotherapy activities
- **Plant architecture**
- **Water areas** and phytodepuration
- **Composting** centre

Serenity

- **Therapeutic gardens** for different types of users
- **Protected areas** for recollection and meditation
- **Outdoor library** and book crossing areas
- Areas with **ponds**
- **Shaded relaxation areas**

Exercise

- **Cycling infrastructure** (paths, covered parking spaces)
- **Pedestrian** infrastructure
- **Changing rooms** with showers
- **Spaces for sport** and physical activity, dedicated to different types of users (children, the elderly, athletes, rehabilitation)
- **Electric vehicle** interchange areas
- **Smart bus** shelters to wait for public transport

Animals

- **Fenced green spaces** for grazing
- **Butterfly Garden**
- **Beehive**
- **Areas for human-animal interactio**n and pet therapy

Biodiversity
conservation and acceleration

Ecosystem wellbeing

The Health Park covers the entire hospital area (18.5 hectares) and constitutes a new public park in Cremona, open to everyone. The Park will be the **green lung of the New Hospital;** the green areas, both those equipped and those natural regeneration through spontaneous vegetation and shrubs, with a low level of maintenance, will be for the benefit of the community and for the **harmonious development of local plant and animal species**, with a view to an ecosystemic well-being. The designed green spaces will be characterized by various functions comprising: cultivated spaces, therapeutic spaces, relaxation and refreshment areas, etc. These typologies interact consistently with non-rigidly designed parts of untamed or informal, with trees, and linking external green spaces in a cohesive and integrated way.

The **connection with existing landscapes** and systems surrounding the Park aiming at sewing together the urban tissue and the Cremonese countryside will be favoured. The activities and facilities inside the park will have a **minimal impact** on the life of animal and plant species, especially with regard to noise and light pollution. The design of the green spaces shall take into account the **autochthonous and endemic plant systems,** encouraging the expansion of animal species nesting or travelling through the area, with a special focus on pollinator species. The project will need to prioritize defragmentation actions while focusing on preserving and enhancing link points. [6]

Guidelines

- **Integration of the ecosystems** of green areas within the site with systems outside;
- Design of green areas according to **biodiversity principles**, respecting existing environmental systems;
- **Revegetation** of existing urban areas for the continuity of local ecosystems;
- Implementation of **ecological corridors**;
- Use of native and **endemic species**;
- Promotion of plant species that attract **pollinating animals**;
- Provision of **refuge and nesting** areas;
- Use of green areas and natural strategies to **mitigate climate change**;
- **Prevention and mitigation** of light and noise pollution.

SHENZHEN MANGROVE WETLAND MUSEUM,
HASSELL STUDIO
The museum creates an important ecological link between the different coastal habitats of Shenzhen Bay.

Lesson learned:
The design of green areas for biodiversity and environmental regeneration is also closely linked to human well-being.

Green management and maintenance

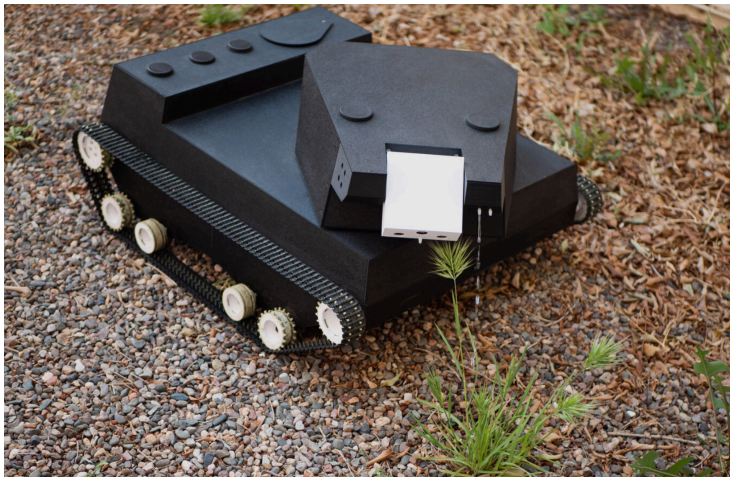
Automated and responsive systems

The Park will provide an opportunity to integrate and test innovative and automated systems for the **continuous management and monitoring** of green areas and the landscape. The provision of strategic, management and technological innovations for the maintenance of the Park is encouraged. Low-tech systems for integrated weed and pest management and control, through the use of permaculture green systems and integration with animals, are encouraged.

Technological innovations, such as robots, drones, sensors and the Internet of Things (IoT), will become part of the New Hospital's broader monitoring and management system, including through the potential of its digital twin (see 'Digital Infrastructure'), maximizing efficiency and easing the workload of staff. The monitoring of the health of the plant systems, for example, will take place through sensors capable of collecting data in real time and transmitting it to the central control system. The processed data will trigger automated management actions, alerting staff only when necessary.

Guidelines

- Use of new technologies to **monitor, perceive and maximize** resources;
- Innovative **low-tech strategies** for green maintenance and management;
- Envisaging **integrated systems and automated processes** for park care, such as irrigation, pruning, planting, integrated pest and weed control (e.g. providing advanced irrigation systems based on real-time data, such as soil moisture, current weather and weather forecasts);
- Implementation of sensors for **proactive, remote and autonomous monitoring** of water resources, soil quality and vegetation health, etc;
- Adoption of innovative strategies and connected devices integrated into the **hospital's digital twin platform**, with the aim of transforming the Health Park into a test-bed for new technologies;
- Raising awareness of the **natural environment**.

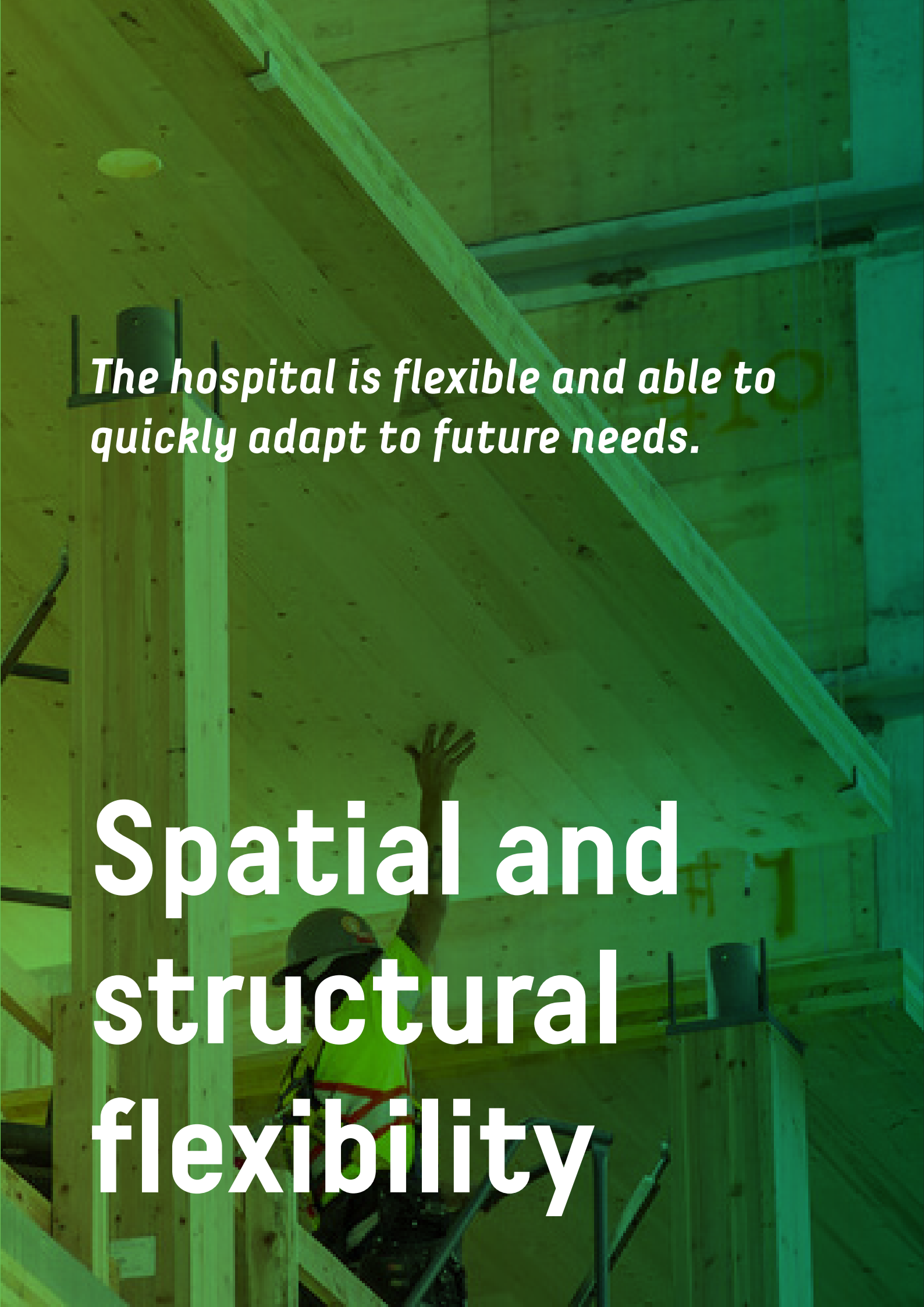


YARDROID

Through sensors and artificial intelligence, the autonomous robot can autonomously mow the lawn, water in every direction, and administer herbicides and pesticides, seeds and fertilizers.

Lesson learned:

heavy manual work can be replaced by machines and artificial intelligence, resulting in improved management and prevention of physical harm.



The hospital is flexible and able to quickly adapt to future needs.

Spatial and structural flexibility

Flexible building system
adaptable and scalable architecture

Flexible and multipurpose spaces
time schedule and adaptability

Flexible plant system
modular and efficient installations

Internal flows
route differentiation, optimization and adaptability

The hospital becomes an open and adaptable platform able to modify according to changing needs.

The entire healthcare sector is **constantly and rapidly evolving** to adapt to clinical protocols to the constant evolution of the technology dedicated to them, to the changes of patients' habits and expectations and to the variations of the demographic and, obviously, to respond to any emergency situations. These reasons make it indispensable for the hospital to be featured by a **high-degree flexibility** allowing to design a hospital easily adaptable to the changing context of future needs.

Flexibility and adaptability are among the key factors to be considered while designing the New Hospital, in all its components and project axes. The design must employ strategies that make the hospital a platform open to the future, in order to provide buildings, layouts and amenities that can modify their set-up when changes in the requirements framework occur. Prefabricated construction systems, adaptable architectural features and modulated plant arrangements guarantee the adaptability and scalability of the building; multipurpose, versatile and reconfigurable paths and spaces allow for optimal use of space and resources.

Flexible building system
adaptable and scalable architecture

New configurations, functions and dimensions

One of the New Hospital's challenges is to establish an **unprecedented model of healthcare structure**, adapted to current needs but able to adapt to future changes. Therefore, flexibility in its architecture is one of the design's founding principles, based on buildings open and ready for diverse configurations, so as to allow **future functional and spatial modification set-ups**, which are also able to guarantee the structure's scalability, i.e. the possibility of expanding and reducing it according to different necessities. Such modifications must be accommodated for by the building methodology and the suggested technologies, for instance by disassembling, displacing, or reconfiguring parts.

To minimize disturbance, the construction method will also have to take into account the **necessity of continuing to use the current hospital facility while the New Hospital is being built**. Design systems for off-site production in a controlled factory environment and using digital tools, as well as innovative on-site construction technologies, should be assessed to offer benefits such as, optimization of construction time, safety for workers, minimizing levels of dust and noise pollution on-site, high quality control of the entire process and reduction of resource consumption, and minimal impact on the day-to-day activity of the current Hospital.

Guidelines

- Building design according to **flexibility, adaptability and expandability;**
- Choice of construction technologies allowing construction **modalities while the existing hospital is being used**, e.g. through off-site, prefabricated and assembled constructions;
- Use of **scalable, demountable, reconfigurable and recyclable building elements** and interior partitions;
- Adaptability and possibility of reuse of the building or parts of it at the **end of its life**.

AL DAAYAN HEALTH DISTICT MASTER PLAN, DOHA, OMA

The modular cross-shaped units, prefabricated on site, can be reconfigured and expanded with minimal disruption to ongoing processes, greatly reducing the cost of future modifications. A typically austere architectural typology may once again incorporate adornment thanks to 3D printing, which offers limitless variants in façade design.

Lesson learned:
the hospital is conceived as a constantly moving organism that transforms its spaces according to the event and the necessary circumstances.

FLEXIBILITY ACCORDING TO DIFFERENT STAKEHOLDERS[7]

- **Nursing managers**

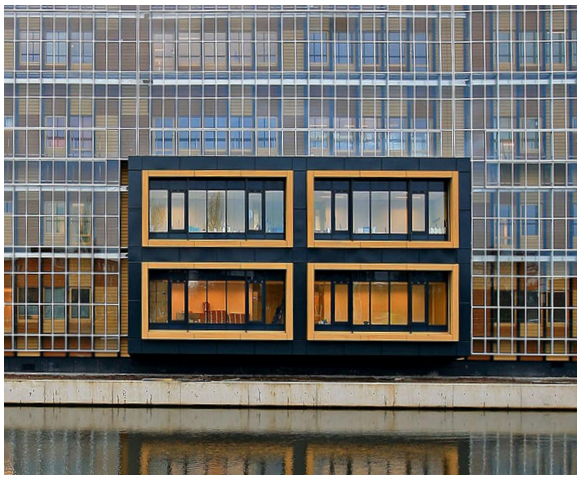
"Flexibility is seen in operational terms, as the ability to adapt, change function and modify in response to patient care and employee needs."

- **Health administrators**

"Flexibility is seen in organisational terms, with major focus on market and community needs and in terms of management efficiency."

- **Facility manager**

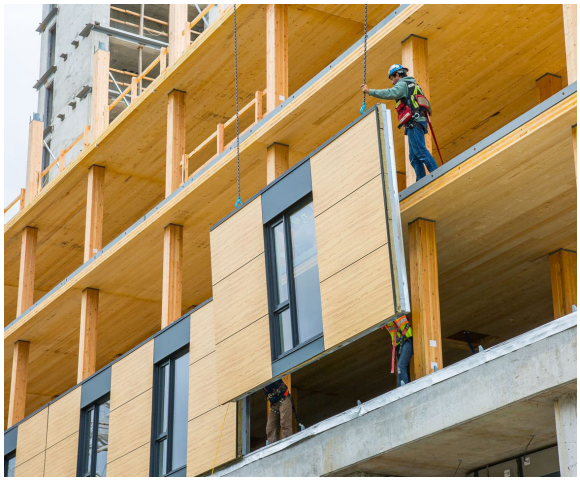
"Flexibility is viewed in spatial terms, in relation to changing technology, standardization, modifiability, use and multipurpose capacities."



NEW MARTINI HOSPITAL, GRONINGEN
SEED ARCHITECTS

With the help of mobile partitions and removable accessories, it is possible to make changes in terms of layout, without creating an obstacle to adjacent rooms. For example, it is possible to move electricity, medical gas and water supply points, as well as meters and cabinets and even add new volumes on the façade.

Lesson learned:
The constructive and plant flexibility allows the interchangeability of functions, as well as the provision of non-hospital functions.



BROCK COMMONS TALLWOOD HOUSE
URS ACTON OSTRY ARCHITECTS INC

An innovative 18-storey hybrid timber building at the University of British Columbia (UBC).
The timber structure was completed in less than 70 days after the prefabricated components arrived on site, about four months earlier than a typical project of that size.

Lesson learned:
Engineered wood products are versatile, high-performance building materials, especially with regard to environmental goals, and offer great possibilities in creating flexible configurations.

Flexible and multipurpose spaces time schedule and adaptability

A responsive and multipurpose hospital

The New Hospital will consist of multipurpose and versatile spaces, which will be designed to adapt to future uses that were not necessarily anticipated throughout the planning and construction phases. The architectural elements and furnishings that will make the spaces up will therefore be **convertible, demountable or retractable,** to allow the functional layout to be easily modified, while keeping the structure of the building unchanged.

For example, traditional waiting rooms could be replaced by areas equipped for study or smart work, or spaces for interaction between the various users, and between the latter and the staff. Outpatient and clinical spaces and private inpatient spaces will also be designed to **allow maximum flexibility of use**.

The functional adaptability of multi-purpose spaces can be managed, in addition to flexible layout design, by means of **digital reservation systems** available to staff for scheduling activities according to the rooms dedicated to the different clinical reservations in order to share, and thus, optimize space resources.

Guidelines

- Design of **multi-use and multipurpose** communal spaces;
- Configuration of **clinical spaces** to accommodate any new functions;
- Preparation of private areas for **compartmentalization/expandability reconfigurations**;
- Use of easily **removable and interchangeable partitions**;
- Selection of **multi-purpose and movable furniture**, accessories and equipment;
- Maximization of space through **booking systems**, integrated within the hospital's digital twin platform (see chapter "Digital Infrastructure").

SINT MAARTENSKLINIEK
EGM
The use of multifunctional rooms increases the flexibility and efficiency of the hospital. An app provides staff with information on the availability of rooms and the possibility of using the space.

Lesson learned:
Spatial solutions that increase flexibility of use, reduce building volume and optimize resources.

Flexible plant system
modular and efficient installations

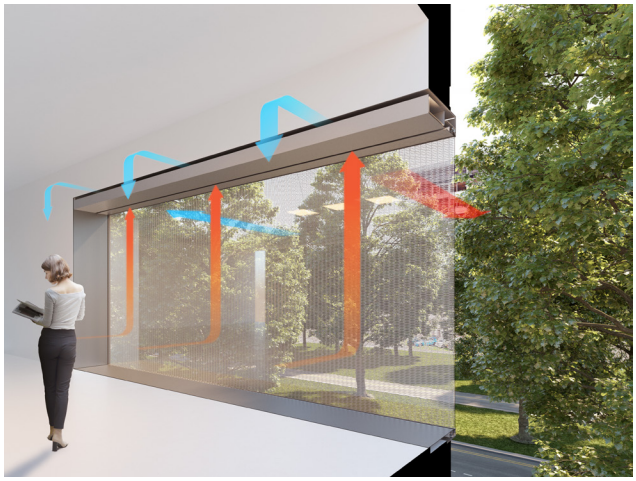
Integrated systems for flexibility

Like the building system, MEP (Mechanical, Electrical and Plumbing) systems will also have to be designed for **flexibility and future convertibility.** It will be necessary to design the systems with allowances for future implementations and various configurations in order to achieve optimum energy efficiency.

The entire plant network shall allow remote or **automated monitoring and management of microclimate comfort parameters**. The network will therefore be equipped with appropriate sensors and digital control and customization systems, integrated with the digital twin of the New Hospital (see chapter “Digital Infrastructure”).

Guidelines

- Optimizing and maximizing **plant efficiency**;
- Maximizing **microclimatic comfort**;
- Construction of modular installations, in order to allow for **easy division or extension in the future**;
- Use of **energy-efficient installations**, e.g. by providing LED lighting that is automatically dimmed according to available daylight;
- Possibility for users to **independently control and adjust lighting** and interior temperature according to their personal needs;
- Implementation of **digital monitoring** to measure consumption.



SMART WINDOW, OPEN INNOVATION CENTER,
CARLO RATTI ASSOCIATI + SELLA GROUP, TORINO

The pilot project of the Open Innovation Center sets itself the challenge of designing the post-COVID office. The project proposes an “intelligent window” to guarantee health, safety and sociality. The air exchanges are managed directly in each single window, reducing the exchange of air between different rooms and providing continuous circulation between inside and outside which limits the spread of microorganisms.

Lesson learned:
Innovative plant systems can contribute to sustainability and flexibility.

Internal flows
route differentiation, optimization and adaptability

Design strategies and new technologies

The New Hospital will be organized according to a **distinction of flows based on the optimization of routes** to ensure the best quality and speed of services. In particular, specific short and efficient **staff routes** will be identified to minimize travel. Along these routes, "on-stage" and "off-stage" areas which allow staff to manage interaction times and modalities (see chapter "Architecture for well-being").

Patient pathways are designed with patients' comfort and ease in mind, thus lessening confusion and promoting social engagement, creativity, physical exercise, and walking, as well as using wayfinding techniques to aid in orientation (see chapter "Mobility and flows").

The creation of distinct routes for the **movement of goods** and for different types of users, as well as the use of automated technologies for horizontal and vertical movements, can aid in the optimization and distribution flexibility.

Guidelines

- **Optimized route planning**, including strategic functional distribution, aimed at shortening and enhancing personnel flows;
- Envisaging of private or **'off-stage' routes** and spaces dedicated exclusively to staff;
- **Differentiation of flows** for patients, staff, visitors, goods and merchandise;
- Use of innovative technologies for **horizontal and vertical movement** of people and materials.

BELLEVUE CLINIC SEATTLE CHILDREN'S HOSPITAL
NBBJ
The hospital makes efficient use of the floor plan layout to reduce staff time and distances. Such features contribute in reducing the overall floor area of the building.

Lesson learned:
The organization of internal spaces and flows is closely linked to the needs of staff and users. It needs continuous monitoring and design solutions that ensure flexibility and adaptability.

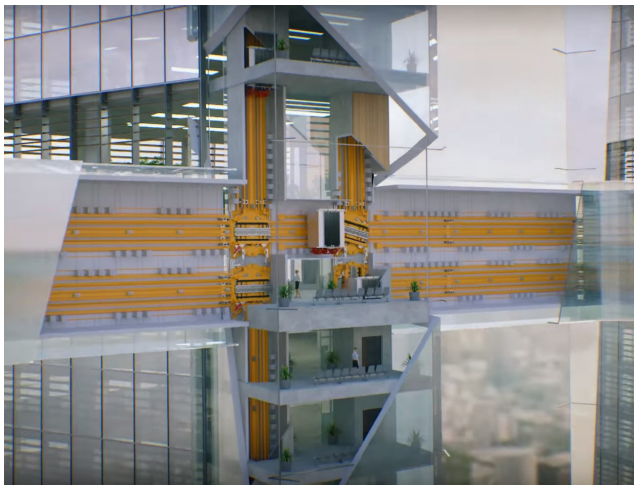
LOMA LINDA UNIVERSITY MEDICAL CENTER'S EXPANSION

NBBJ

The hospital consists of an open core design in which the main support functions such as staff lockers, break rooms and conference rooms are located in a centralized hub that connects to the patient wards.

Lesson learned:

An efficient design prevents personnel from making pointless trips, which lowers workplace stress.



GERMAN PAVILION, EXPO 2020, DUBAI

MULTI ELEVATOR SYSTEM

The cable-free lift is capable of vertical and horizontal movement. It features several cabins moving within a single shaft, in a loop, similar to a vertical metro system. The system also allows for a greater load capacity and reduced dimensions and weight.

Lesson learned:

Through innovative, state-of-the-art mobility systems such as horizontal lifts reducing the design constraints imposed by traditional lifts, the building's internal mobility system can be challenged.

NEW SOUTH GLASGOW UNIVERSITY HOSPITAL

A fleet of robots move supplies, including laundry and food, using underground tunnels. They also have a unique elevator system that allows them to move from floor to floor. The robots will even recognize if a human enters the elevator.

Lesson learned:

Separation of flows is achieved through the design of dedicated spaces. Robotic transportation of commodities and medical supplies reduces staff workload and enables the use of more efficient and smaller spaces.

The hospital's design is centered on the care and well-being of both patients and staff. Spaces, shapes and materials are formulated to have a positive impact on the patients' mental, social and physical welfare.

Architecture for well-being

Patient design
mindful planning with patients in mind

Staff design
designing with staff at the centre

Social interaction
levels of privacy and sociability

Integration of the natural environment
access to nature for everybody

Hygiene and cleanliness
minimizing infection risk

"A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" is the definition of 'health' provided by the World Health Organisation's.[8]

Numerous studies have demonstrated how environmental factors, such as architecture, may influence health and even rate of recovery. **Architecture can be an important tool** for making workplaces **safer for employees and more therapeutic for patients**.

Physical space qualities help individuals feel less stressed, emotionally stable, socially cohesive, and healthier overall. Due to its **emphasis on the quality and definition of space**, the New Hospital promotes itself as a supporter of the wellbeing of patients, guests, and employees.

Patient design
mindful planning with patients in mind

Process and architecture around the patient

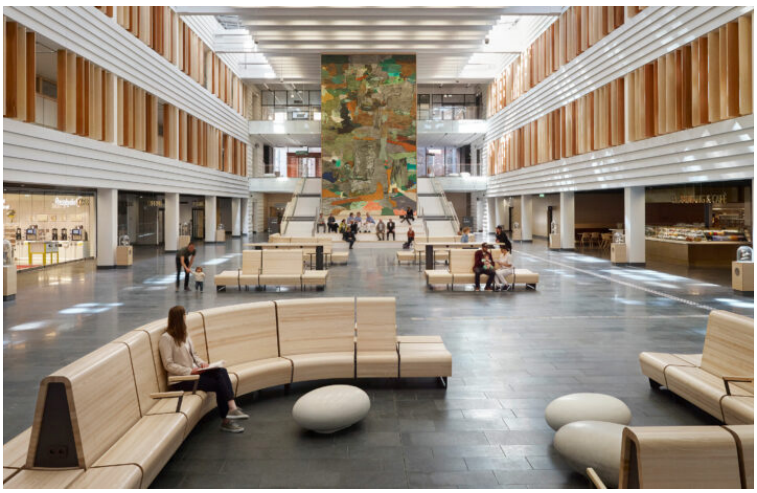
Patient design or design around the patient is one of the New Hospital's founding prerogative. Planning strategies must take into account the **complete patient experience (patient journey)** and the design itself must guarantee a comfortable and welcoming atmosphere that encourages **autonomy, safety, privacy and control over one's environment**. This implies not only defining spaces, forms and sensitive aspects of design, but also structuring a new organizational model, which results in new functional distributions in the building.

Guidelines

- Envisioning **innovative operational and organizational models** that enable an efficient and smooth patient journey;
- Application of a **functional distribution** that enhances processes;
- Use of spaces, forms and architectural elements that meet the **specific needs of different types of users** and ensure universal accessibility;
- Creation of private spaces to ensure a **sense of autonomy**, with a preference for single bedrooms.

GARDNER NEUROSCIENCE INSTITUTE, UNIVERSITY OF CINCINNATI, PERKINS&WILL
Each component of the complex neurological treatment facility was created with input from patients, relatives, and caregivers in order to address the unique requirements of the patients. (susceptibility to nausea, dizziness, fatigue, movement disorders).

Lesson learned:
Patient design aims to search for and apply the most suitable solutions to meet patients' needs.



KAROLINSKA UNIVERSITY HOSPITAL, SOLNA (SWEDEN), WHITE ARCHITECT
Care is organized according to subject areas (oncology, pediatrics, emergency medicine, cardiology, inflammation and ageing, women's health) and functions (medical diagnostics, perioperative medicine and intensive care).

Lesson learned:
In open structures as in thematic areas, the patient with multiple needs is at the centre of the process.

Staff design
designing with staff at the centre

Peaceful and safe working environment

The Covid-19 pandemic has accelerated and highlighted burnout and turnover among clinical staff in hospitals.[9]

The New Hospital aims at **fostering staff well-being and develop into a desirable place where working is enjoyable and stimulating**. The environment must ensure a serene, efficient and safe style of working. Diverse high-quality restricted areas for employees to unwind or liaise with colleagues, as well as supplemental services for their benefit, are envisaged.

Guidelines

- Integration of **different types of spaces dedicated to personnel** that guarantee privacy and detachment from the public area ("off-stage" spaces);
- Creation of **supplementary services** for the benefit of staff (dedicated or shared);
- Implementation of strategies for **improving working conditions** (e.g. route optimisation, automation of repetitive tasks, ergonomics).
- **On-stage/off-stage spaces** for medical staff;
- Promoting the **quality of architecture** for staff spaces.

MASSACHUSETTS GENERAL HOSPITAL, LUNDER BUILDING, BOSTON (USA), NBBJ
Spaces dedicated to staff are large, calm and exposed to natural light; private corridors allow them to access the rooms from outside and the large glass staircase accessible only to staff has become a meeting and decompression space.

Lesson learned:
Private spaces dedicated to staff are not residual: they take advantage of the best views and exposure to natural light.

OXFORD UNIVERSITY HOSPITAL, NHS (NATIONAL HEALTH SERVICE), UK
The focus on staff well-being has led the OUH to create programmes aimed at supporting staff on six dimensions of well-being: emotional and psychological, physical, social, financial, occupational and intellectual, and environmental.

Lesson learned:
Staff well-being is also defined by the provision of services to improve various spheres of their health.

Social interaction
levels of privacy and sociability

Social well-being

Social well-being and interaction have a positive influence on **health and stress reduction**. Within the New Hospital there should be **spaces for meeting and socializing**, of different sizes and with different degrees of privacy and activity.

The design of these spaces should have such features to ensure to all users the **privacy and comfort** that they need. Recreational activities and functions, may promote social connection.

Guidelines

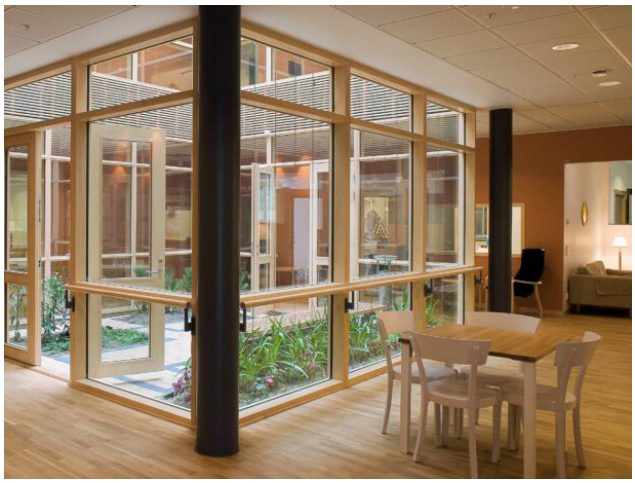
- Integration of different **size shared spaces and with different degrees of privacy** to ensure encounters and interactions with others;
- Creating spaces that are **flexible and adaptable to user preferences**, e.g. by providing moveable furniture and partitions;
- Creation of **different types of spaces**, between quiet spaces and activity spaces, designed for different types of users;
- Use of **common areas**, central spaces with clear sight lines for the staff.

CONSISTENCY AND CONTROL
Medical personnel, particularly in the emergency and acute care areas, are regularly confronted with potentially traumatizing events. An important resilience factor is the 'sense of coherence', i.e. the feeling that one's **workload is manageable, meaningful and consistent**.[10]

Another important factor is the internal locus of control, i.e. the feeling of **having control over one's actions**.[11] These factors can be facilitated and increased through design.

SENSE OF PURPOSE
The **meaning that people attribute to their existence** usually lies outside of the hospital walls, for example in family, friends, art, music, sport or religion. Inside healthcare facilities, patients are cut off from social interaction and the outside world.

Healthcare architecture, stereotyped as sterile and obsolete, must incorporate **spaces for recreation and for social support**, so as to strengthen the sense of purpose.[12]



ÖSTRA SJUKHUSET, GÖTEBORG, SWEDEN, WHITE ARCHITECTS
The psychiatric facility and shared spaces were designed with stress-reducing features based on Evidence-Based Design (e.g. reducing crowding stress, reducing environmental stress, positive distraction, design for visibility). Compared to the old facility, there was a decrease in the number of infections and the number of physical restraints for aggressive behaviour.

Lesson learned:
Design can reduce stress and aggressive behaviour.

SAYANOMOTO CLINIC, SAGA (JAPAN) YAMAZAKI KENTARO DESIGN WS
The focal point of the project is a special communal space called 'Learning' overlooking the garden. A calm space where dementia patients, families and staff can interact and connect through learning.

Lesson learned:
Shared spaces that include recreational functions support interaction.

Integration of the natural environment
access to nature for everybody

Contact with nature

Physical and visual access to nature has proven benefits in **stress reduction, increased pain tolerance and faster recovery times.** The New Hospital maximizes opportunities for contact with nature for patients, visitors and staff.

The Health Park is also **"accessible"** to those who are unable to leave their rooms, e.g. through views, terraces, green roofs, indoor cultivation, greenhouses, winter gardens, etc.

Guidelines

- Integration of **natural elements** into the built environment;
- Design with easy **access to outdoor areas and natural elements** for all users, including on the highest floors of buildings (e.g. through terraces, green roofs, etc.);
- Design with a **focus on views of natural environments** (including the Health Park, terraces, green roofs, indoor cultivation, greenhouses, conservatories, vertical gardens, fountains, representations, etc.).

PASONA HEADQUARTER, TOKYO, KONO DESIGN

The nine-storey building comprises offices, an auditorium, cafeterias, a roof garden and an urban farm where fruits, vegetables and rice are harvested. Employees are encouraged to contribute to the harvest, as well as having access to the farm (with cows, pigs and goats) on the 13th floor.

Lesson learned:
The integration of nature into the building can take many forms: from green façades to indoor farming.

BRONSON METHODIST HOSPITAL, KALAMAZOO, MICHIGAN

Unable to develop an outdoor garden due to unfavourable weather conditions, the atrium was designed as a large greenhouse in the centre of the hospital. The hospital wings radiate from it, making it easily accessible to all.

Lesson learned:
Bringing nature inside the hospital makes it accessible without having to go outside.

VIEW ON NATURE

A pioneering study in 1984 showed how postoperative recovery time was influenced by **open views to the outside world**.[13]

Several studies have since confirmed that the presence of gardens promotes a **feeling of 'escape' from stress** that is of great importance in restoring health and can also be passive, such as looking out of a window.[14]

Even **realistic depictions** of natural environments help to calm patients.[15]

8 CONCEPTS FOR WELL-BEING

Materials

Healthy, natural and antibacterial materials

- Preference for natural and non-toxic materials
- Preference for materials that are healthy for humans and the environment
- Preference for antibacterial and easy-to-clean materials

Light

Natural lighting

- Maximizing dissemination
- Easy access from any environment

Artificial lighting

- Differentiation according to function
- Customization

Suono

Acoustic comfort

- Passive and active noise reduction strategies
- Definition of an internal and external soundscape, including the emission of artificial or natural sounds (e.g. the sound of water, animals, etc.)

Air

Natural ventilation

- Maximizing dissemination
- Easy access from any environment

Mechanical ventilation

- Air exchange and sanitization

Temperature

Thermal comfort

- Thermal insulation strategies
- Microclimate control strategies

Smell

Olfactory comfort

- Definition of an internal and external olfactory landscape
- Attention to the control and mitigation of strong, unpleasant odours

Colour

Natural colouring

- Preference for natural and non-toxic

Artificial colouring

- Differentiation according to function
- Selected with a focus on psychological impact and ease of cleaning

Art

Positive distraction

- Integration of different types of art forms (visual, acoustic, tactile) and through different media (physical or digital)
- Involvement of different types of users in the artistic experience (universal accessibility)

PERSONALIZATION

Factors such as **light, sound, temperature need to be customizable**, so that patients and staff can recreate conditions to suit their needs.

Artificial light, for example, should be **designed as flexible**, so that intensity and colour can be changed as required. Sufficient light must be provided in patients' rooms for visits by medical staff; but it is also desirable that these light supplies can be adjusted by the patient at will for resting, reading and receiving visitors.

DESIGN FOR WELL-BEING

The choice of spatial and architectural elements has a great impact on user well-being. Recent research confirms that architectural factors such as **distance from the nursing station, single room and the presence of a direct line of sight** are crucial in influencing clinical outcomes. [16]

In addition, **design features** such as reduced noise, lighting, ventilation, ergonomics and spatial distribution help to reduce errors, limit stress, improve sleep and ease pain. [17]

Hygiene and cleanliness
minimizing infection risk

Easy and efficient cleaning

Hygiene and cleanliness are fundamental characteristics of the hospital space, and for this reason require the definition of **specific strategies** capable of guaranteeing them.

The choice of **materials, colours, construction details, technological integrations** (e.g. by integrating automated cleaning processes) must be guided, among other factors, by ensuring ease and efficiency in cleaning. The choice of materials, in particular, must ensure healthiness and reduce exposure to toxic materials and by-products.

Guidelines

- Defining materials, colours and construction details that **easily guarantee clean and healthy surfaces**;
- Use of materials that are **healthy, safe and free of harmful chemicals**;
- Use of **natural materials** wherever possible;
- Adoption and integration of innovative **technologies for cleaning and sanitizing** air and surfaces to increase efficiency and reduce caretakers' work.

RHÖN-KLINIKUM CAMPUS, BAD NEUSTADT, GERMANIA
A mobile, self-contained UVD disinfection robot integrates UV-C light to disinfect surfaces, as well as air, from viruses and bacteria.

Lesson learned:
Automated solutions and new technologies are integrated into the design and processes to optimize cleaning and hygiene and support staff in operations.

GRINNELL REGIONAL MEDICAL CENTER, GRINNELL, IOWA (USA)
By applying copper alloy surfaces in 13 of the 26 medical-surgical rooms and on 20 high-contact surfaces in patient rooms and indoor bathrooms, the hospital was able to demonstrate that the choice of material reduced bacteria levels by an average of around 98%.

Lesson learned:
The choice of materials contributes strongly to hygiene and a healthy environment.

THE GREENARY, CARLO RATTI ASSOCIATI, PARMA

The old farmhouse has been renovated to maximize natural light and provide the best conditions for the tree integrated within it. The design takes advantage of technology and the microclimate of the surrounding area to control temperature and humidity, so that the tree and the occupants of the house can coexist comfortably.

Lesson learned:
Nature and people coexist harmoniously in the built environment.

The hospital becomes low-carbon, from design to material procurement, from construction to operation, to disassembly, reuse and end-of-life.

Sustainability and circular economy

Sustainability framework
values and objectives

Decarbonization
low CO_2 emissions over the entire life cycle of the building

Circular Economy
resource recovery and valorization cycles

Material bank
management of building materials and architectural elements

Energy production
towards an energy community

Healthcare as a sustainability engine

Health care facilities play a peculiar role with regard to the environment that hosts them, a **footprint conditioned** by choices in the use of raw materials, emissions, waste and effluent production and the mobility requirements associated with their functionality.[18]

Sustainability is one of the core values in the rapidly evolving healthcare sector.

The New Hospital in Cremona will seize the opportunity to set a **global leader in the field of environmental protection** by definitely reducing emissions over its life cycle and building an infrastructure itself resilient to changes induced on the ecosystem (climate, social, demographic, etc.).

The hospital is a **forerunner in innovative management of resources** and medical waste and will have a circular approach on a global scale. The New Hospital will include continuous monitoring of emissions, of air quality and consumption, with a view to constant advancement.

Sustainability framework
values and objectives

Sustainability standards

The New Hospital is in line with European and global sustainability goals. The design will have to demonstrate that it is in line with the 2030 Agenda's demands for addressing current society's challenges.
Designers are encouraged to apply sustainability standards such as the European Taxonomy classification, LEED BD+C Healthcare certification, the WELL protocol, etc.

EXAMPLES OF SUSTAINABILITY STANDARDS

SDGs Sustainable Development Goals

"The Sustainable Development Goals (SDGs) that make up the 2030 Agenda refer to different areas of social, economic and environmental development, which need to be considered in an integrated manner, as well as the processes that can accompany and foster them in a sustainable manner. All UN member states are to achieve the SDGs globally by 2030" [19]

1. No Poverty
2. Zero Hunger
3. Good Health and Well-being
4. Quality Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation and Infrastructure
10. Reduced Inequality
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life on Land
16. Peace and Justice Strong Institutions
17. Partnerships to Goals

EU Tassonomy and climate assessment

The European taxonomy is the action plan on financing for sustainable growth. It defines a common classification system for sustainable economic activities, so that we can meet the EU's 2030 climate and energy targets and the Green Deal objectives, such as decarbonisation by 2050, incentives for renewables and regeneration energetic. [20]

Identification of 6 environmental and climate objectives:

- Climate change mitigation
- Adaptation to climate change;
- Sustainable use and protection of water and marine resources
- Transition towards the circular economy, waste reduction and recycling;
- Prevention and control
- Protection of biodiversity and ecosystem health

National implementations

- National Recovery and Resilience Plan (PNRR)
- Integrated National Plan for Energy and Climate

LEED BD+C: Healthcare

LEED Building Design and Construction: Healthcare is the most widespread sustainability protocol for healthcare buildings worldwide. It has been developed primarily for hospitals, outpatient and long-term care facilities, whether these are new builds or, major renovations of housing, interior spaces and facilities. [21]

Topics subject to evaluation

- Site sustainability
- Water efficiency
- Energy and atmosphere
- Materials and resources
- Indoor environmental quality
- Innovation in design
- Regional priorities

WELL V2™ Building Standard

The WELL protocol provides a framework for improving the interaction between building and human health, optimizing the health and well-being of staff, patients and visitors in a hospital setting, thus enhancing the holistic view in the design, construction and operation of the building. 'health care. [22]

Structured into 10 concepts consisting of distinct health characteristics and intents

- Mind
- Community
- Movement
- Water
- Air
- Light
- Thermal comfort
- Nutrition
- Sounds
- Materials

Protocol strategies for the well-being of patients, staff and visitors

- Integration of design elements and artwork
- Lighting to ease the mood
- Connection with nature
- Regenerative spaces
- High indoor air quality
- Promoting an active lifestyle

Decarbonization
low CO_2 emissions over the entire life cycle of the building

Efficient and closed-loop hospital

Globally, the healthcare sector is responsible for 4.6 per cent of total greenhouse gas (GHG) emissions. [23]
Due to their intensive 24-hour operation, hospitals are among the **most energy-intensive building types**. The electricity consumption of a hospital is generally three to four times higher than that of a residential building. [24]

Action must be conducted during both the usage phase and the **whole life cycle of the building** since the sector's imperative decarbonization process concentrates on reducing both operational and embodied carbon emissions.

As a result, the New Hospital will employ strategies including bioclimatic, solar optimization, shading, optimized thermal mass, air tightness, decreased thermal bridges, maximized use of sunshine, passive ventilation, etc. to **drastically reduce its energy consumption**. [25]

The hospital will have tools for **managing and continuously monitoring** the building's energy and environmental performance; the occupants will be involved and informed and will in turn be equipped with systems able to personalize their indoor climatic comfort. The hospital will be geared towards achieving zero carbon emissions, and will compensate for the remaining emissions with carbon offsets. The building's emissions will be quantified over its entire life cycle, considering all inputs from the production, transport, construction, use phase, end of life and any additional benefits.

Guidelines

- **Bioclimatic, passive and site-specific** design;
- **Climate resilience and adaptation** to extreme climate events;
- **Maximization of envelope**, plant and microclimate comfort efficiency;
- **Minimization of land consumption** through strategic and smart massing;
- **Reduced operational and embedded emissions**;
- Promoting the use of **electric and shared transport**;
- Prevention and **reduction of consumption** (water, waste, soil, materials, food, etc.);
- **Rainwater recovery**;
- **Grey water treatment** and recovery with biological filtration;
- **Food waste prevention** and recovery;
- Integration with **recycling infrastructure**;
- Adoption of plant energy solutions that **minimize CO_2 consumption and emissions**;
- **Production and supply of energy** from renewable sources;
- **Continuous monitoring** of energy and environmental performance;
- Provision of instruments to **control and monitor climatic comfort** for occupants.

THREE-TIERED APPROACH TO DECARBONIZATION [26]

To achieve decarbonization of the building sector, several strategies can be implemented that focus on combinations of energy efficiency, renewable energy and carbon offsetting, in the order of priority reflected in the following table.

Operational emissions

Energy efficiency	before	Renewable energy
On-site renewable energy	before	Off-site renewable energy
Renewable energy	before	Carbon offset

Embodied emissions

Carbon reduction	before	Carbon offset

KLINIKUM FRANKFURT HÖCHST
WÖRNER TRAXLER RICHTER

The hospital is the first to be Passive House certified. Thanks to its compact shape and high level of airtightness, the new building saves about 75 per cent of energy costs compared to the old hospital building.

Lesson learned:
Designing in terms of shape, orientation, openings and envelope is the first step in a sustainable approach to buildings.

OSPEDALE PEDIATRICO DI SALONICCO
RENZO PIANO BW

The sustainable strategy for the building includes glulam construction for the horizons, columns and beams. Solar photovoltaic cells on the roof and 30 km of geothermal wells provide 100 per cent of the heating and part of the cooling.

Lesson learned:
Innovative technological solutions not only allow for energy independence, but also lend a bold architectural character and quality.

Circular Economy
resource recovery and valorization cycles

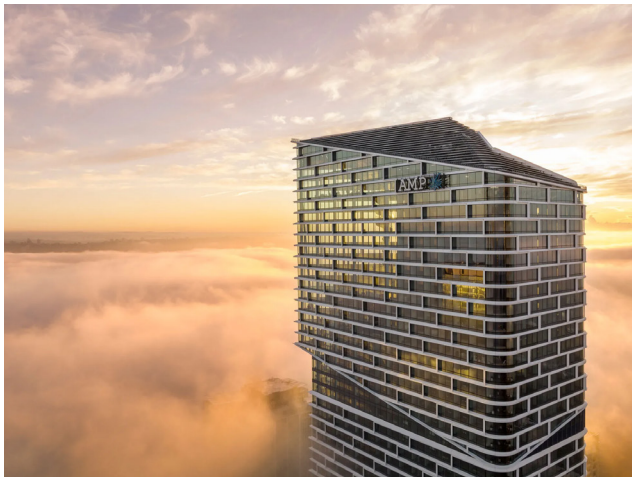
From the Linear Hospital to the Circular Hospital

A circular economy is a **restorative or regenerative system**, which replaces the concept of end-of-life with that of restoration, moves towards the use of renewable energy, eliminates the use of toxic chemicals, which undermine reuse, and aims to eliminate waste by designing with durable materials and products. Three **key principles** guide circular designin the New Hospital: eliminate waste and pollution, keep products and materials in use, and regenerate natural systems.

The New Hospital is therefore built according to criteria of disassemblability of parts, it makes use for example of **upcycled and regenerative materials**, thus reducing the production of solid waste on the site.

Guidelines

- **Disassemblable, adaptable and flexible** building;
- Circular approach in the use of materials and **management of hospital waste** and scrap;
- Assessment of the **environmental impact** of the building during its life cycle;
- **Carbon footprint assessment** of materials and total emissions;
- Reduction of Greenhouse Gas (GHG) emissions and environmental impact throughout the **building's life cycle**;
- Inclusion of **circular economy principles** to increase cost and resource efficiency (construction and operational waste, water and food);
- Inclusion of **upcycled and bio-based materials**;
- **Reuse and recycling of structures** and materials currently present in the hospital.



QUAY QUARTER TOWER
3XN ARCHITECTS
The new building salvages and reuses 65% of the columns, beams and floors, as well as 95% of the structural walls, from the existing building. The project was estimated to save the client approximately 85,000,000 Euro and a total of 7,505 tons of CO2, compared to a complete demolition.

Lesson learned:
Reusing structural components and parts reduces costs and lessens the building's impact on the environment.

Material bank
management of building materials and architectural elements

Controlling material flows in the life cycle

The hospital will be built with the use of a **'materials passport'** for the identification of reliable and standardized information on the flow and composition of the construction products and materials used, from their arrival at the construction site to their dismantling and reuse.

The information provided by these datasets will mainly indicate the environmental impact, any certifications, physical, chemical, biological and process properties, health and safety aspects, location within the building, and take into account the present and future use value of the product. This information will be **constantly monitored** through the building's digital twin, allowing traceability of materials and products throughout their life cycle and beyond. The materials used in the building will mainly be those with the lowest carbon footprint, regenerative and renewable, possibly with verified environmental certifications, as well as upcycled or recovered materials from the existing hospital building.

Guidelines

- **Material passport**;
- Use of construction materials with **reduced environmental impacts**;
- Use of **certified materials**;
- Use of **regenerative and renewable materials**;
- Integration of a **physical and digital material bank**, where all building materials and components are catalogued together with their material passports (electrical, electronic and construction waste) from the building site to final use;
- Adoption of a **digital twin system** integrated with the Material Passport.

TRIODOS BANK, NETHERLANDS
RAU ARCHITECTS
The building is realised as a temporary assembly of products, components and materials with a documented identity. All elements of the building are bolted together, which means that every time the building is dismantled, the circular potential that can be activated is 100%, without loss of value of materials, components and products.

Lesson learned:
The reuse of all products, components and materials is possible thanks to accurate documentation of all component information (material bank).

Energy production
towards an energy community

Renewable energy production for the hospital and community

The New Hospital will opt for **energy production systems from renewable sources**, such as solar, wind, biomass, etc. Such production systems could be integrated into both the hospital building and the Health Park, e.g. through smart furniture, photovoltaic shelters, mini wind power, etc.

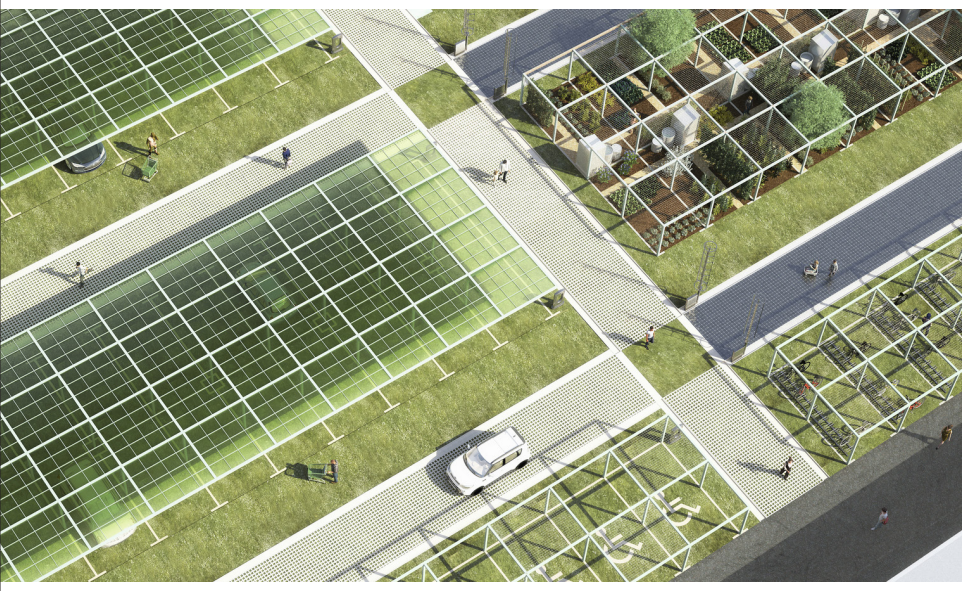
In order to manage any energy excess, and be as autonomous as possible during unfavorable weather or in the event of power grid outages, and be able to share these surpluses with the community in case of need, it will be required to employ storage solutions for the energy generated, such as batteries.

Guidelines

- Use of **clean and renewable energy**;
- **On-site and off-site production** of energy for part of the building's requirements;
- Provision of **energy storage systems**.

ERASMUS MC
EGM
The building is equipped with a Pharmafilter waste purification plant into which waste from kitchens, sanitary units and operating units flows. Water purification and fermentation plants convert it into clean water and biogas to meet the energy needs of the centre.

Lesson learned:
Even hospital waste can be transformed into a sustainable energy resource.



GUNDERSEN LUTHERAN MEDICAL CENTER

HSR ASSOCIATES,

The hospital generates electricity from renewable sources using wind turbines and solar panels; it produces thermal energy using locally sourced renewable biomass, geothermal energy for heating and cooling, and energy from waste.

Lesson learned:

Relying on renewables permits to produce energy to cover the needs of the hospital.

The hospital has a 'digital twin' aiming at boosting efficiency, customize services and assess potential solutions.

Technological Infrastructure

Monitoring and management
digital platform

Sensor system
real-time data collection

Automation and Artificial Intelligence
process optimization

Customization
of space and services

"The digital hospital of the future will have a control system similar to that used for air traffic, able to constantly monitor patients and interweave data to define the best 'flight paths' for them"[28]

Today, all human beings are easily identifiable through the **processing of their personal data** obtained and managed also by AI systems. In the age of Big Data, we are increasingly witnessing the interaction between the physical world and its digital model. In this area, the **BIM methodology** serves as linchpin to the 4.0 industry of the AECO (Architecture, Engineering, Construction and Owner-operated) sector in its increasing digitization.

Within the New Hospital, through an intensive use of the sensor system, a **high volume of data will be available**: the localization of patients and their state of health, the flows of staff and capital and consumer goods (drugs, instruments, food, waste), the functioning of diagnostic and biomedical equipment, and building conditions and parameters such as temperature, humidity, lighting, sound, etc.

Data collection can be funneled to control centres, where information is combined, analyzed, and used allow to **make decisions on the on the clinical management of patients** also at home on the maintenance of the most appropriate conditions of functionality of infrastructures and facilities etc. Within static or dynamic databases, the data is saved in an organized and useable manner. This is the real work's alphanumeric set, which is linked to it by means of enabling technologies to establish a true digital twin or digital twin (DT).

Monitoring and management digital platform

Monitor building, patients and staff

The information gathered, appropriately protected by cyber security systems, are **easily accessible to staff and operators by means of a single platform and remotely**, allowing them to optimize complex workflows, the attainment of an excellent grade of energy efficiency, the effective and timely response to emergency situations, the increase of the level of security and enhancement in general of the usage experience of the building.

Through **control and management systems** (Building Management System - BMS), operators can monitor and manage operations within the New Hospital throughout the building's entire lifecycle - from design, to operation and, in the end, decommissioning.

The **continuous monitoring of flows** (of the location and health status of patients within the hospital, the professionalism and ongoing operations of staff, etc.) will help to further optimize processes inside and outside the New Hospital.

The **real-time occupancy of spaces**, for example, will ensure greater energy efficiency through automated temperature management; the monitoring of home patients enables effective management of medical procedures for tele-assistance.

Guidelines

- Envisaging a **BIM methodology for the digital twin of the building in all its phases**, providing the opportunity to test in the digital space before implementation in physical form, from the beginning of the project in parallel with the design and consultation phases;
- Using the **digital twin as the main tool for collecting data** and evaluating key success metrics;
- Envisaging of an **integrated digital platform** for real-time monitoring and information management.

DIGITAL TWIN FROM DESIGN TO END OF LIFE

The DT is composed of three elements: **real space, virtual space and interconnections** that allow the continuous exchange of information. In particular, the virtual replica consists of the BIM model, a multidimensional model understood as a static relational database.

In fact, the virtual copy represents the **real work on different 'dimensions'**, allowing constant control over the state of the building; from construction time management (dimension 4D), to dynamic cost management (dimension 5D) to sustainability and energy efficiency (dimension 6D) and facility management (dimension 7D). The infrastructure that forms the connection includes the use of IoT sensors (temperature, motion, etc.) and management platforms which allow the recording of dynamic data stored within servers that exploit time series databases (TSDBS - Time Series Database Server).

Sensor system
real-time data collection

Integrated and 'mobile' sensors

Different types of **sensors integrated into the built environment** form an intelligent ecosystem capable of constantly monitoring what is happening inside the New Hospital. A sort of **neuronal network** consisting, for example, of sensors for monitoring temperature and hygrometric conditions, sensors for fire safety, surveillance chambers, location sensors, sensors for controlling and monitoring access and openings in general etc.

Other 'mobile' sensors (attached to moving subjects and objects) form the basis for Real-Time Location Systems (RTLS). These systems enable **real-time monitoring and management** of the staff, patients, electromedical and biomedical equipment of the technical assets within the New Hospital. In addition, the **diffused network of medical parameter detectors** is appointed to monitor the clinical status of patients and inpatients even if dislocated in local facilities or at home.

In the New Hospital, **the digital level integrates to the physical level**: information, aggregated through a dense layering of interconnected digital elements, will be superimposed on the built environment, transforming it and produces data that feed the clinical, logistical and administrative management systems of the New Hospital.

Guidelines

- Integration of an **ecosystem of fixed and 'mobile' sensors** to optimize processes and experience;
- Data collected by IoT sensors throughout the hospital site can be **aggregated and made available** with appropriate data privacy and consent measures for use by the public or private sector;
- The data collected from different sensors will be aggregated into a single platform that allows the **network to be upgraded and downsized** with less upfront investment and possibilities for future growth;

MAYO CLINIC, USA
"WORLD'S BEST HOSPITAL 2022"
Artificial intelligence (AI) is applied to the Apple Watch ECG recordings to identify patients with a weak heart pump; the data is uploaded to their electronic medical records automatically and securely via an app.

Lesson learned:
The ECG of a smartwatch can accurately detect heart failure in non-clinical environments. [29]

Automation and Artificial Intelligence process optimization

Robotic and automated systems

In order to maximize efficiency, the architecture of the New Hospital must **take into consideration the new automated planned processes**. To accommodate the new systems, it is vital to determine which new spaces must be provided to accommodate the new systems, while also maintaining flexibility for the integration of new automation models in the future.

An autonomous **robotic system for the distribution of equipment and supplies**, for example, could enjoy dedicated channels for horizontal and vertical movement, as well as storage and recharging areas. The application of robotic and automated systems within the New Hospital should be aimed at **supporting staff, lightening the workload and taking care of repetitive actions**, such as, drug management, distributing meals and medicines to patients, monitoring their vital functions, transporting laboratory samples, linen, medical equipment and waste; these are just some of the tasks that can be automated, leaving time for staff to manage activities with patients and deal with more professional and qualified heath and assistance tasks thus allowing a constant and more empathetic interaction with the patients.

Technology and evolving spaces

The configuration of the New Hospital allows, favouring a suitable definition of processes and spaces, the **timely adoption of innovations** that transform the clinical discipline both in the very hospital and the home care.

Artificial intelligence, robotics, 3D printing, genetic coding, personalized drug creation, are just some of the innovations that will make **healthcare more personalized and precise**. Many medical devices will become smaller, reducing the need for space today for bulky equipment.

Guidelines

- Integration of a **network of robotic and automated systems** to optimize processes and maximize efficiency;
- Envisioning **models of operations and space management** that take into account current and future developments in medicine and healthcare.

TUG ROBOTS,STANFORD HOSPITAL, PALO ALTO, CALIFORNIA (USA)
Autonomous robots travel miles along hospital corridors, transporting medicines, meals, medical supplies, linen and waste. Staff can control the position of the 'robotic assistants' and call them when needed, wherever they are.

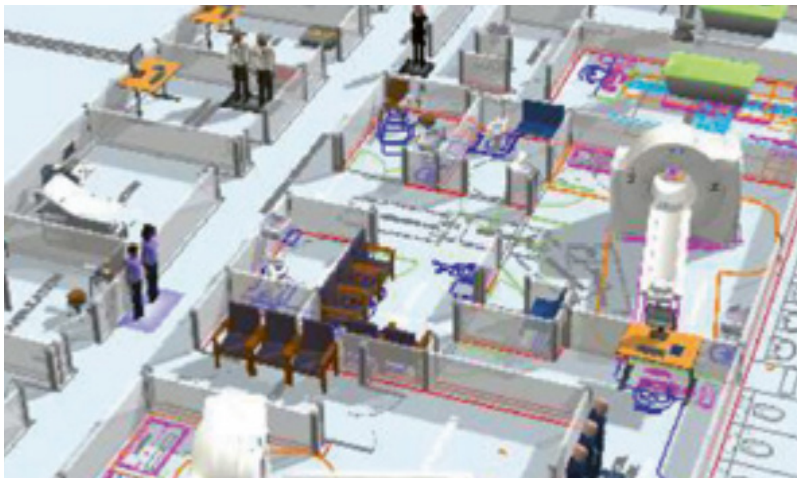
Lesson learned:
Automation helps to perform repetitive and tiring tasks, easing the burden on staff.

ARTIFICIAL INTELLIGENCE IN MEDICINE

In recent years, Artificial Intelligence has **contributed and revolutionized** every area of our lives, including medicine, reshaping healthcare. The applications are numerous: from data management (collecting, classifying and tracking huge sets of medical information already available), to the analysis and confrontation of the same even to identify potential personalized treatment plans.

AI is setting the stage for **precision medicine**. While traditional medicine tries to define one-size-fits-all medical solutions based on the statistical needs of a typical person, the ability of AI to analyze large amounts of information will increasingly lead towards the creation of targeted treatments, **personalized therapies and uniquely compounded drugs**.

AI will also have an **impact on healthcare**: for example, the AI Cure app supported by the National Institutes of Health uses a smartphone webcam and artificial intelligence to **autonomously monitor** if patients are taking their medication properly, and following the prescribed therapies, supporting them by making sure they know how to manage their condition. [30]

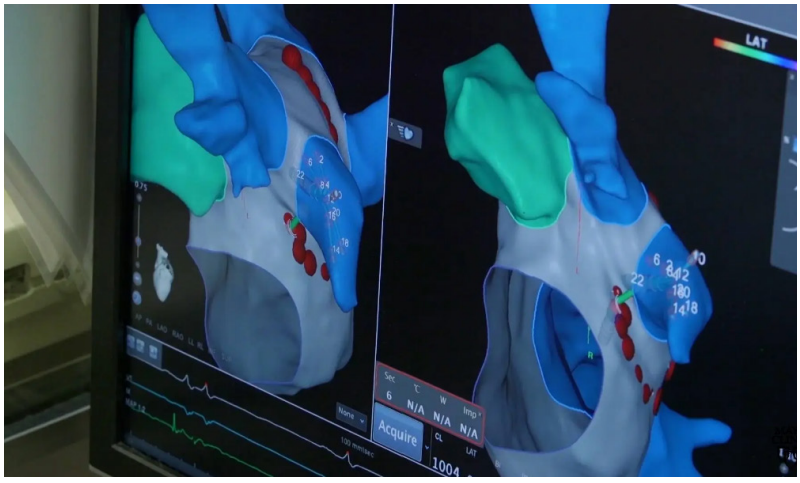


MATER PRIVATE HOSPITAL, DUBLIN, IRELAND, SIEMENS

The hospital used a digital model (digital twin) of its radiology department to test different operational scenarios and layouts through AI. The simulation helped predict the operational and financial impact of any possible scenario, to evaluate the options and find the best solution to implement.

Lesson learned:

The digital twin becomes a simulation tool for future enhancements.



MAYO CLINIC ARIZONA (USA)

The artificial intelligence model used by the Mayo Clinic Arizona can predict individuals at high risk of heart attack or stroke by analyzing cardiovascular calcifications.

Lesson learned:

Imaging-related artificial intelligence also contributes to preventive health by predicting events and being proactive in preventing them

Customization of space and services

The environment 'recognizes' users

Mobile sensors paired with patients and staff not only provide information on their behaviour and health status, but also allow us to understand which are their preferences.

A series of historicized data, such as dietary preferences, the times and types of medication to be taken, the desired temperature in one's room, the colour of the light, the view from the window and favourite music, will **allow the New Hospital to 'recognize' its users** and provide them with personalized services, from personal wayfinding to room settings thanks to connected devices.

Similarly, users themselves will be allowed to have **access to varying degrees of action and possibilities** to modify their environment, for instance by choosing the optimal parameters for their own room or shared spaces. Personalization and personal comfort can lower stress levels and thus accelerate recovery.

Works of art and interactive games integrated into the environment can engage users of different types and age groups and provide them with opportunities to meet with others and provide positive distraction.

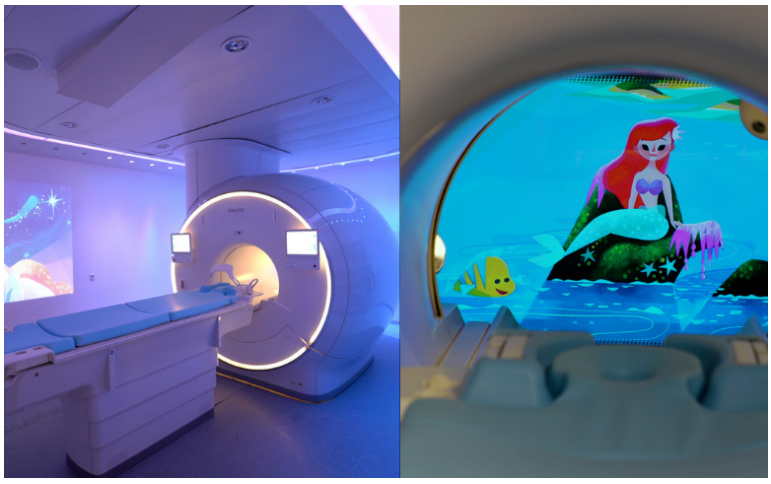
Guidelines

- Envisaging **customized services and processes** based on historical patient and staff data;
- Integration of **customized environment systems** accessible by patients and staff;
- Envisaging **interactive systems** capable of involving patients of different types, with specific needs and different age groups.

QUIRÓNSALUD + SITUM

Indoor navigation and monitoring solutions were implemented in several hospitals and health centres of the group. A mobile app guides patients and visitors with detailed instructions. Directions can be set according to different criteria, e.g. with special routes for patients with disabilities.

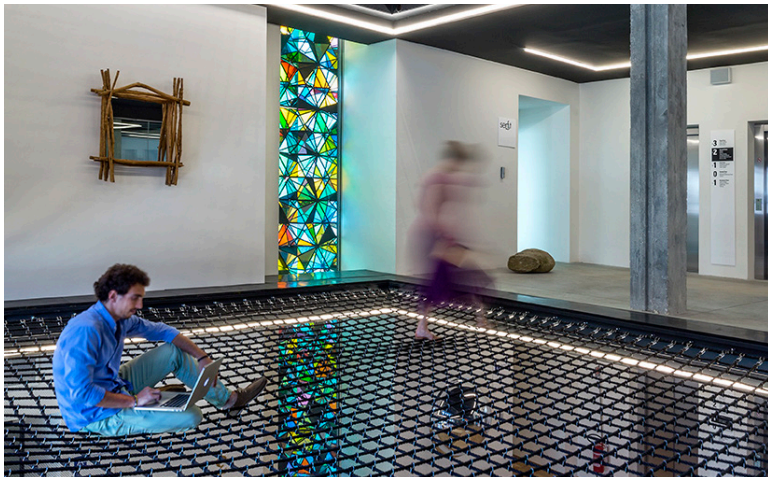
Lesson learned:
Customized services allow each user to receive information set to their specific needs.



PHILIPS + DISNEY

The collaboration aims to test the effects of customized animation, including specially created Disney stories, within the "Philips Ambient Experience" which integrates architecture, design and technologies, such as dynamic lighting, video projections and sound, to enable patients and staff to personalize the environment.

Lesson learned:
Personalization and art come together to create a calming environment.



FONDAZIONE AGNELLI, TORINO, CARLO RATTI ASSOCIATI + SIEMENS

The building was equipped with sensors that monitor various data sets, including the position of the building's occupants, temperature, CO2 concentration and the availability of meeting rooms. Through an app, each user can interact with the Building Management System (BMS) and customize their experience.

Lesson learned:
Personalizing the conditions of the environment increases efficiency.

4 Patient Journey

Patient Journey and Staff Journey description of Personas

Patient Journey

Hospital service:
Day Hospital

"I was born and raised in Cremona, in the historic centre. I have been living alone for years and don't often see my son, who works in another city."

Hospital service:
Emergency admission

"I moved to Cremona to study, I live in a small flat near the university. During my free time I love being outdoors and playing sports."

Sandro

- Man;
- 67 years;
- Widower;
- Has a son;
- Doesn't drive.

General clinical condition

- Chronic disorders;
- Suffers from diabetes, cardiovascular disease, depression.

Critical issues in the experience

- Difficulties in changing lifestyle;
- Logistical difficulties in carrying out follow-up examinations;
- Lack of psychological assistance;
- Lack of assistance at home.

Opportunities for the New Hospital

- Complete check-up in day hospital;
- Telematic assistance for monitoring;
- Nutrition education course with nutritionists.

Examples of supplementary services

- Concentration of examinations in one location and at one time;
- Spaces dedicated to relaxing and emotional decompression;
- Multifunctional spaces for group therapy, courses and social interaction;
- Training for self-care at home;
- Continuous virtual assistance via the app.

Sofia

- Woman;
- 23 years;
- Not married;
- No children;
- Lives alone.

General clinical condition

- Generally healthy;
- Femur fracture.

Critical issues in the experience

- Long and protracted waiting times;
- Uncomfortable hospital room;
- Low-quality power supply;
- Rehabilitation service not provided in a timely manner.

Opportunities for the New Hospital

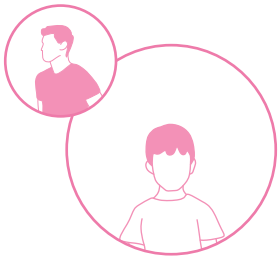
- Telematic medical consultations;
- Customisable inpatient room;
- Customised and km 0 feeding;
- On-site rehabilitation at an equipped facility.

Examples of supplementary services

- Emergency tel-visit;
- Adjustment of comfort parameters (light, temperature, blinds...);
- On-site restaurant and preparation of customised meals;
- Telematic physiotherapy via home-training;
- Equipped spaces for in-house rehabilitation.

In this chapter we describe some hypothetical care paths as examples, comparing a current (Patient Journey - today) and a future (Patient Journey - tomorrow) experience.

The integrative services of an innovative hospital model can have a positive impact on the user experience within the hospital, as well as on the staff experience (Staff Journey).



Hospital service:
Planned hospitalisation

"I live in Milan with my mum, dad and little sister. I really like animals and playing with my friends in the park."

Giulio

- Child;
- 8 years;
- Neoplastic disease in progress;
- Allergic diseases;
- Lives with his parents and a younger sister.

General clinical condition

- Disease in progress.

Critical issues in the experience

- Moments of boredom and loneliness;
- Hospitality in an aseptic and inhospitable space;
- Difficulties for parents in managing the family;
- Lack of psychological support for caregivers.

Opportunities for the New Hospital

- Fun activities on site;
- Preparation for admission;
- Stay in a caregiver facility;
- Rehabilitation in the open air, with animals and in a controlled environment.

Examples of supplementary services

- Play areas for children of different ages;
- Therapeutic gardens for different types of users;
- Private spaces rented short-stay for patients and visitors.

Staff Journey

Hospital job description:
Resident internist

"My partner, my daughter and I moved to Cremona to be closer to my place of work, while remaining in contact with nature in our house with a garden just outside the city."

Marta

- Woman;
- 32 years
- Married;
- Lives 7km from the hospital with her husband and a son;
- Does not own a car.

General working condition

- Works in the hospital 45-50 hours/week.

Critical issues in the experience

- Difficulties in reaching the workplace;
- Lack of digitisation of processes;
- Difficulties in managing family life;
- Lack of time to study.

Opportunities for the New Hospital

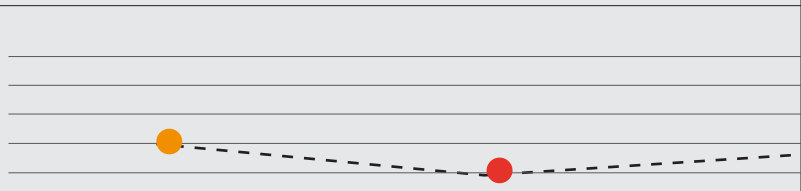
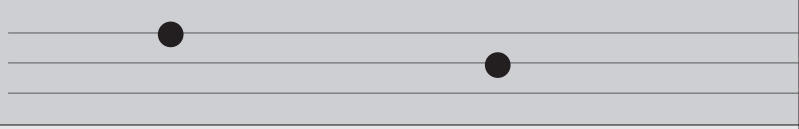
- Stations and car parks dedicated to multimodal mobility;
- Digital collection of clinical data;
- Neighbourhood services;
- Integrative wellness services.

Examples of supplementary services

- Multimodal hub and dedicated parking spaces within the hospital;
- Creation of electronic patient records and real-time data collection and sharing;
- Food services and neighbourhood shops nearby;
- Spaces for emotional decompression and focus.

Patient journey - today
Day Hospital

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Unsatisfied
- Very unsatisfied

PHASES	EVENT		
TIMING	1 WEEK		
STEPS OF THE JOURNEY	**1 | SYMPTOMS**	**2 | VISIT**	**3 | EXAMS**
SATISFACTION WITH THE EXPERIENCE			
ACTIONS	• Difficulty breathing and weakness in carrying out normal daily activities.	• Visit to the attending diabetologist; • Suspicion of possible heart failure; • Need to perform specific tests and possible cardiological visit.	• Diagnostic-instrumental insights in private outpatient clinics.
CRITICAL ISSUES	• Onset of a new malaise.	• Very long waiting times for booking the visit; • The physical presence of the patient is required.	• Long waiting times in public facilities; • High cost of services in private clinics.
TOUCHPOINT	 Hospital Neighborhood hubs Home / remote		

Sandro

- Man;
- 67 years;
- Widower;
- Has a son;
- Doesn't drive.

General clinical condition

- Chronic disorders;
- Suffers from diabetes, cardiovascular disease, depression.

Critical issues in the experience

- Difficulties in changing lifestyle;
- Logistical difficulties in carrying out follow-up examinations;
- Lack of psychological assistance;
- Lack of assistance at home.

VISIT		THERAPY / SUPPORT	FOLLOW-UP CARE
1 MONTH		DAILY ROUTINE	ANNUALLY
4 | REPORTS	**5 | DIAGNOSIS**	**6 | THERAPY**	**7 | FOLLOW-UP**
• Withdrawal of reports in the structure; • Reading of the reports with a diabetologist, in presence; • Need for cardiology visit.	• Cardiological visit in a private clinic; • Heart failure diagnosis. • Consultation among the doctors treating the various pathologies to define the best therapy.	• Long-term drug treatment for diabetes and heart failure; • Encouragement to adopt a healthy lifestyle	• Annual check-ups for various chronic diseases, at various locations; • Individual Diagnostic Therapeutic Care Path for each attending physician.
• Waste of time in the collection in the presence; • Physical presence of the patient not required for the reading of the reports.	• Long waiting times in public facilities; • High cost of the visit performed privately.	• Lack of psychological support; • Lack of support in following therapies and complying with recommendations.	• Waste of time for exams on different days; • Limited communication between treating physicians and between the various therapies.

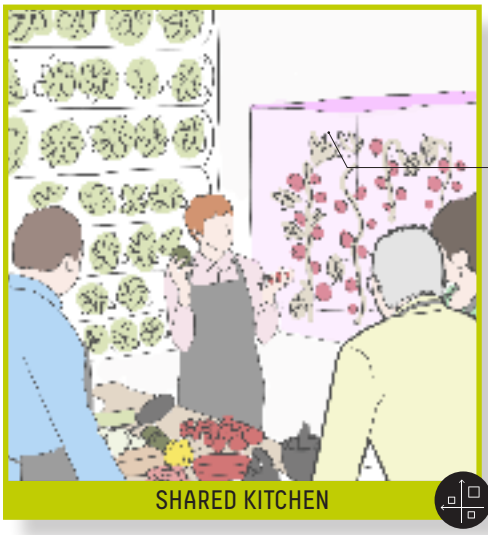
Patient journey - tomorrow
Day Hospital

Synchronization parameters patient on all devices via wearables

Wearables for monitoring

PHASES	EVENT		
TIMING	1 WEEK		
STEPS OF THE JOURNEY	1 | SYMPTOMS	2 | VISIT	3 | EXAMS
SATISFACTION WITH THE EXPERIENCE			
ACTIONS	• Difficulty breathing and weakness in carrying out normal daily activities.	• Tele-visit with the treating diabetologist; • Suspicion of possible heart failure; • Need to perform specific tests and possible cardiological visit.	Admission to day hospital to perform diagnostic-instrumental investigations in 24 hours.
OPPORTUNITIES		• Saving time in planning the visit; • Save time by not having to physically move.	• Time optimization of the conduct of visits.
TOUCHPOINT	Hospital Neighborhood hubs Home / remote		

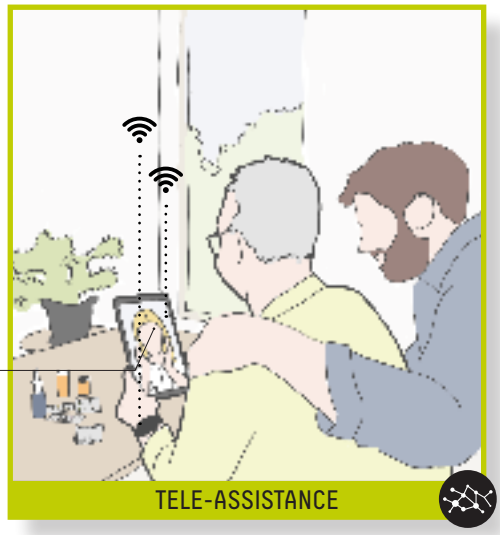
Hospital as a network · Wellbeing for the ecosystem · Patient Journey · Opening up to the city



SHARED KITCHEN

Greenhouses hydroponics

Tele-visit with real-time parameter monitoring via wearable

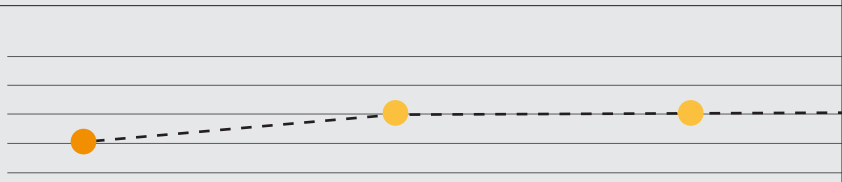


TELE-ASSISTANCE

VISIT		THERAPY / SUPPORT	FOLLOW-UP CARE
1 MONTH		DAILY ROUTINE	ANNUALLY
4 | REPORTS	5 | DIAGNOSIS	6 | THERAPY	7 | FOLLOW-UP
Stay at the guest house while waiting for the reports; Visit and diagnosis by specialist doctors, in the hospital room.		• Long-term drug treatment for diabetes and heart failure; • Encouragement to adopt a healthy lifestyle; Food education course with nutritionists.	• Annual check-ups for various chronic diseases, at various locations; Diagnostic therapeutic pathways shared among treating physicians; • Daily tele-assistance.
• Delivery of reports and diagnosis at the same time.		• Psychological, social and therapeutic support. • Patient education.	• Admission to day hospital (24h) for future visits; • Team of specialists for the care of patients with multiple pathologies.

Patient journey - today
Emergency admission

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Unsatisfied
- Very unsatisfied

PHASES	EVENT	VISIT		
TIMING	1 DAY			
STEPS OF THE JOURNEY	**1 | TRAUMA**	**2 | EMERGENCY ROOM**	**3 | ORTHOPEDIC VISIT**	**4 | EXAMS**
SATISFACTION WITH THE EXPERIENCE				
ACTIONS	• Accidental fall while hiking in the mountains.	• Protected transport to hospital by ambulance; • Assigning a high priority code to triage.	• Specialist visit with the orthopedist of the Emergency Department; • Administration of analgesic therapy.	• Insights diagnostic-instrumental and emaciatomic.
CRITICAL ISSUES	• Sudden trauma.	• Dilated times between arrival at the hospital and the first visit (transition to triage and waiting).	• Insufficiency of information needed for diagnosis.	• Waiting for the exams to take place; • Waiting for reports to be collected.
TOUCHPOINT	 Hospital Neighborhood hubs Home / remote			

Sofia

- Woman;
- 23 years;
- Not married;
- No children;
- Lives alone.

General clinical condition

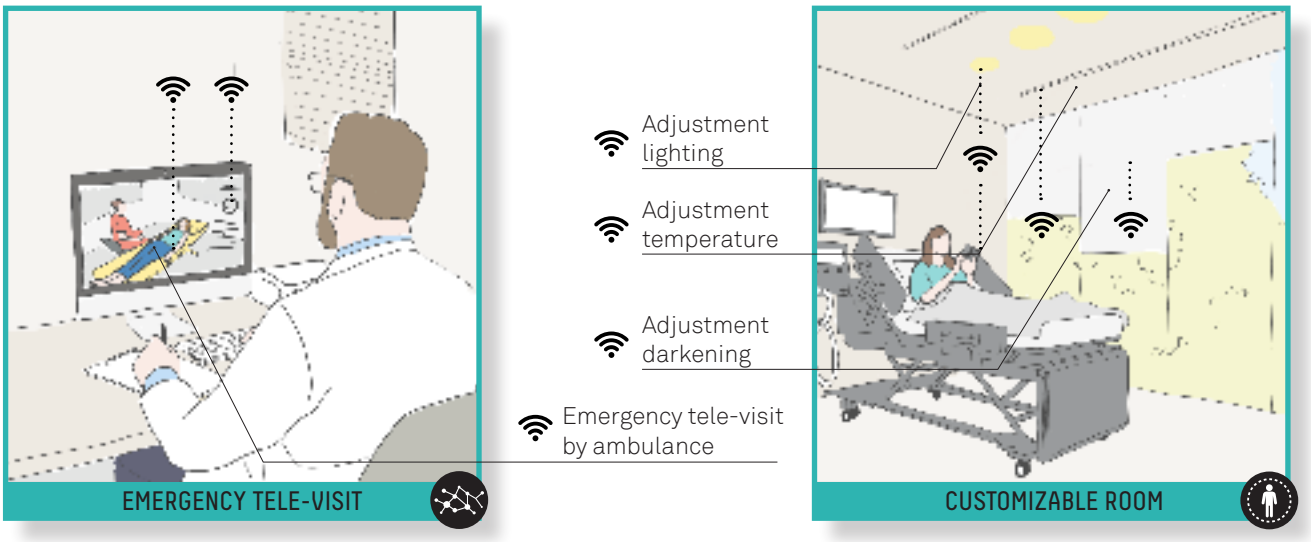
- Generally healthy;
- Femur fracture.

Critical issues in the experience

- Long and protracted waiting times;
- Uncomfortable hospital room;
- Low-quality power supply;
- Rehabilitation service not provided in a timely manner.

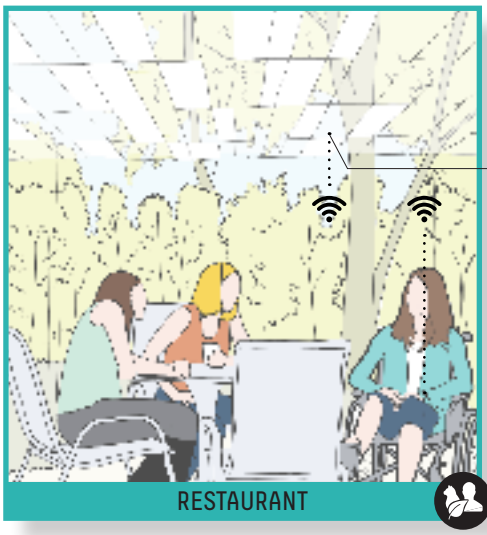
CARE / HOSPITALIZATION		THERAPY / SUPPORT	FOLLOW-UP CARE	
3 DAYS		1 MONTH	7 MONTHS	
5 | DIAGNOSIS	**6 | HOSPITALIZATION**	**7 | DISCHARGE**	**8 | REHABILITATION**	**9 | FOLLOW-UP**
• Fracture of the femur requiring surgery; • Investigations and specialist visit in anticipation of hospitalization and intervention	• Hospitalization in the emergency brief intensive observation and overnight stay; • Emergency operation the following day; • Hospitalization in the ward.	• Aids for the patient's ambulation; • Assistance from family members for returning home.	• First cycle of physiotherapy at the hospital; • Subsequent physiotherapy sessions at a private facility to be paid by the patient.	• Checks in the hospital orthopedic clinic on prescription from the attending physician to verify the progress of the treatment and perfect the rehabilitation treatment plan.
• Strenuous movements back and forth; • Waiting in places not suitable for hospitalisation.	• Constant movement between different departments; • Low level of comfort in the patient room.	• Expensive equipment used for a short time; • Inability to return home independently.	• Transfer to hospital for the start of rehabilitation; • Very expensive and necessary private sessions.	

Patient journey - tomorrow
Emergency admission



PHASES	EVENT	VISIT		
TIMING	1 DAY			
STEPS OF THE JOURNEY	**1 | TRAUMA**	**2 | EMERGENCY ROOM**	**3 | ORTHOPEDIC VISIT**	**4 | EXAMS**
SATISFACTION WITH THE EXPERIENCE				
ACTIONS	• Accidental fall while hiking in the mountains.	• Protected transport to hospital by ambulance; • Emergency tele-visit in the ambulance with the emergency room orthopedist; • Assignment of a high priority code	• Direct entry to the orthopedics department with prescription for instrumental tests; • Administration of analgesic therapy.	• Insights diagnostic-instrumental and emaciatomic; • • Waiting for reports in the relaxation area; • Continuous assistance from the staff.
OPPORTUNITIES		• Efficiency and optimization in the steps of visiting and accepting the PS.	• Less waiting time for exams.	• Waiting in a comfortable and controlled area.
TOUCHPOINT	Hospital Neighborhood hubs Home / remote			

Hospital as a network · Wellbeing for the ecosystem · Patient Journey · Opening up to the city



Lunch
in the park

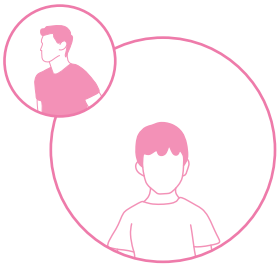
Rehabilitation
in the
swimming pool

CARE / HOSPITALIZATION		THERAPY / SUPPORT	FOLLOW-UP CARE	
3 DAYS		1 MONTH	7 MONTHS	
5 | DIAGNOSIS	**6 | HOSPITALIZATION**	**7 | DISCHARGE**	**8 | REHABILITATION**	**9 | FOLLOW-UP**
• Fracture of the femur requiring surgery; • Further tests in anticipation of hospitalization and intervention in the customizable hospital room.	• Admission to the ward in a customizable single room; • Operation the following day. • Lunch with visiting friends at the restaurant in the park.	• Aids for walking provided on loan from the hospital; • Delivery of medicines through autonomous internal logistics; • Home return service.	• First cycle of home physiotherapy through telematic training; • Subsequent physiotherapy sessions in the equipped structure of the hospital.	• Checks in the hospital orthopedic clinic on prescription from the attending physician to verify the progress of the treatment and perfect the rehabilitation treatment plan.
• Waiting in a comfortable and private area.	• Comfortable room with customizable parameters; • Quality food; • Leisure and sociality.	• Facilitation in finding the prescribed medicines; • Independence and assistance.	• Start of rehabilitation as soon as possible; • Continuation of recovery in an appropriate place.	

Patient journey - today
Planned hospitalisation

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Unsatisfied
- Very unsatisfied

PHASES	EVENT	VISIT		
TIMING	1 DAY	3 DAYS		
STEPS OF THE JOURNEY	1 | SYMPTOMS	2 | PEDIATRIC VISIT	3 | NEUROLOGICAL VISIT	4 | EXAMS
SATISFACTION WITH THE EXPERIENCE				
ACTIONS	• Sudden severe headaches and coordination problems.	• Visit to the attending pediatrician; • Need to follow up with a specialist in pediatric neurology.	• Specialist visit in a private clinic; • Diagnosis of possible neoplastic disease in progress. • Hospitalization planning for exams.	• Admission to day hospital; • Insights diagnostic-instrumental and emaciatomic.
CRITICAL ISSUES	• Sudden onset of discomfort.	• Pediatric visit not necessary in presence.	• Long waiting times in public facilities; • High cost of the visit performed privately.	• Waiting for exams to take place in places with a low level of comfort.
TOUCHPOINT	Hospital Neighborhood hubs Home / remote			



Giulio

- Child;
- 8 years;
- Neoplastic disease in progress;
- Allergic diseases;
- Lives with his parents and a younger sister.

General clinical condition

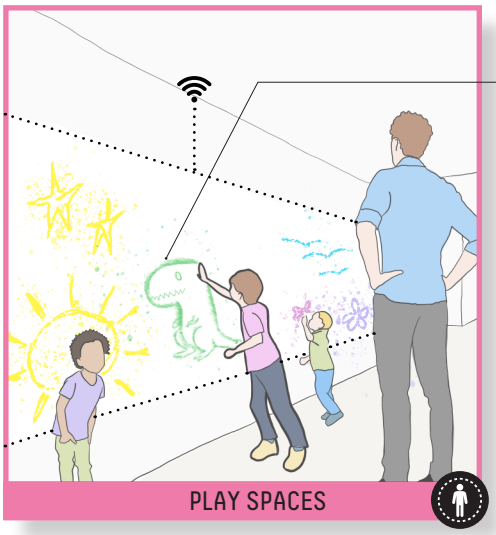
- Disease in progress.

Critical issues in the experience

- Moments of boredom and loneliness;
- Hospitality in an aseptic and inhospitable space;
- Difficulties for parents in managing the family;
- Lack of psychological support for caregivers.

	CARE / HOSPITALIZATION	THERAPY / SUPPORT	FOLLOW-UP CARE
1 WEEK	2 WEEKS	1 YEAR	CADENZA MENSILE
5 | REPORTS AND DIAGNOSIS	**6 | HOSPITALIZATION**	**7 | REHABILITATION**	**8 | DISCHARGE AND FOLLOW-UP**
• Viewing the reports with the neurologist in attendance; • Confirmation of ongoing neoplastic disease.	• Surgery to remove the tumor; • Hospitalization in ordinary hospitalization.	• Cycles of radio and chemotherapy; • Neurological rehabilitation.	• Return to home; • Continuation of care in the facility.
• The physical presence of the patient is not necessary for reading the reports. • Absence of preparatory support.	• Patient room with low level of comfort; • Absence of a bed for the caregiver.	• Rehabilitation in aseptic places, not very stimulating and motivating.	• Lack of medical support for continuous monitoring once you leave the hospital.

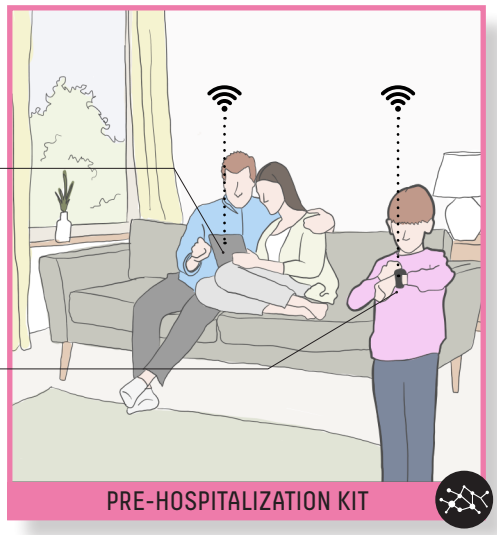
Patient journey - tomorrow
Planned hospitalisation



interactive LED wall

Step-by-step app

Wearable device



PHASES	EVENT	VISIT		
TIMING	1 DAY	3 DAYS		
STEPS OF THE JOURNEY	1 | SYMPTOMS	2 | PEDIATRIC VISIT	3 | NEUROLOGICAL VISIT	4 | EXAMS
SATISFACTION WITH THE EXPERIENCE				
ACTIONS	• Sudden severe headaches and coordination problems.	• Tele-visit with the treating pediatrician; • Need to follow up with a specialist in pediatric neurology.	• Specialist visit with a pediatric neurologist at the hospital; • Diagnosis of possible neoplastic disease in progress. • Hospitalization planning, instrumental tests.	• Admission to day hospital; • Insights diagnostic-instrumental and emaciatomic. • Play areas for children of different ages.
OPPORTUNITIES		• Optimization of time and travel with remote visits.	• Direct booking with the hospital neurologist via the app.	• Entertainment and psychological comfort for young patients.
TOUCHPOINT	Hospital Neighborhood hubs Home / remote			

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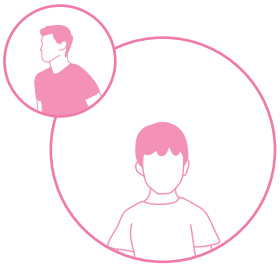
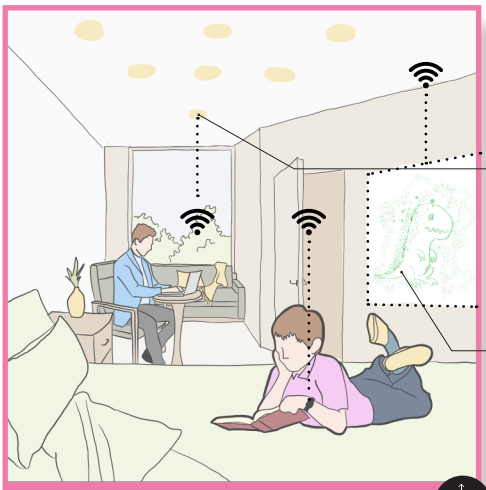




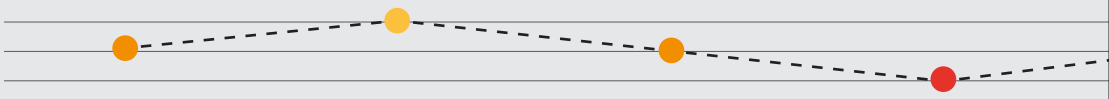
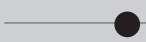
INPATIENT ROOM

THERAPEUTIC GARDEN

	CARE / HOSPITALIZATION	THERAPY / SUPPORT	FOLLOW-UP CARE
1 WEEK	2 WEEKS	1 YEAR	CADENZA MENSILE
5 | REPORTS AND DIAGNOSIS	**6 | HOSPITALIZATION**	**7 | REHABILITATION**	**8 | DISCHARGE AND FOLLOW-UP**
• Viewing reports with the neurologist remotely; • Confirmation of ongoing neoplastic disease; Preparation kit for caregivers with pre-post hospitalization info and support.	• Surgery to remove the tumor; Hospitalization in ordinary hospitalization in a double room with bed for caregiver.	• Cycles of radio and chemotherapy; Neurological rehabilitation in the open air in the therapeutic gardens of the structure.	• Return to home; • Continuation of care at the neighborhood hub; • Weekly virtual assistance for caregiver and patient.
• Optimization with remote visit; • Support and information for patients' families.	• Comfortable room suitable for hosting caregivers.	• Treatments in unconventional and stimulating, controlled spaces.	• Therapy near the home; • Peace of mind for patient families with the guarantee of continuous checks.

Staff journey - today
Resident internist

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Unsatisfied
- Very unsatisfied

PHASES				
TIMING	MORNING			
STEPS OF THE JOURNEY	1 | ACCESS	2 | ORGANIZATION	3 | VISITS	4 | LUNCH BREAK
SATISFACTION WITH THE EXPERIENCE				
ACTIONS	• Departure from home at 6.00 to take the child to kindergarten on foot; • Travel by coach; • I arrive at the hospital at about 7.00-7.15.	• Entrance to the ward/clinic and meeting with nurses; • Meeting with healthcare team and patient discussion.	• Visit of patients with the specialist / meeting of outpatients independently. (10-12 patients in turn).	• 30 minute lunch break; • Eventual lesson/ seminar.
CRITICAL ISSUES	• Wake up early; • Lack of a personal means of transport; • Moving to two different places.	• Notes taken on paper, inefficient and disorganized.	• Little time and little attention to devote to each patient due to the high number.	• Reduced lunch break; • Events for which attendance is required; • Lack of rest.
TOUCHPOINT	 Hospital Neighborhood hubs Home / remote			

Marta

- Woman;
- 32 years
- Married;
- Lives 7km from the hospital with her husband and a son;
- Does not own a car.

General working condition

- Works in the hospital 45-50 hours/week.

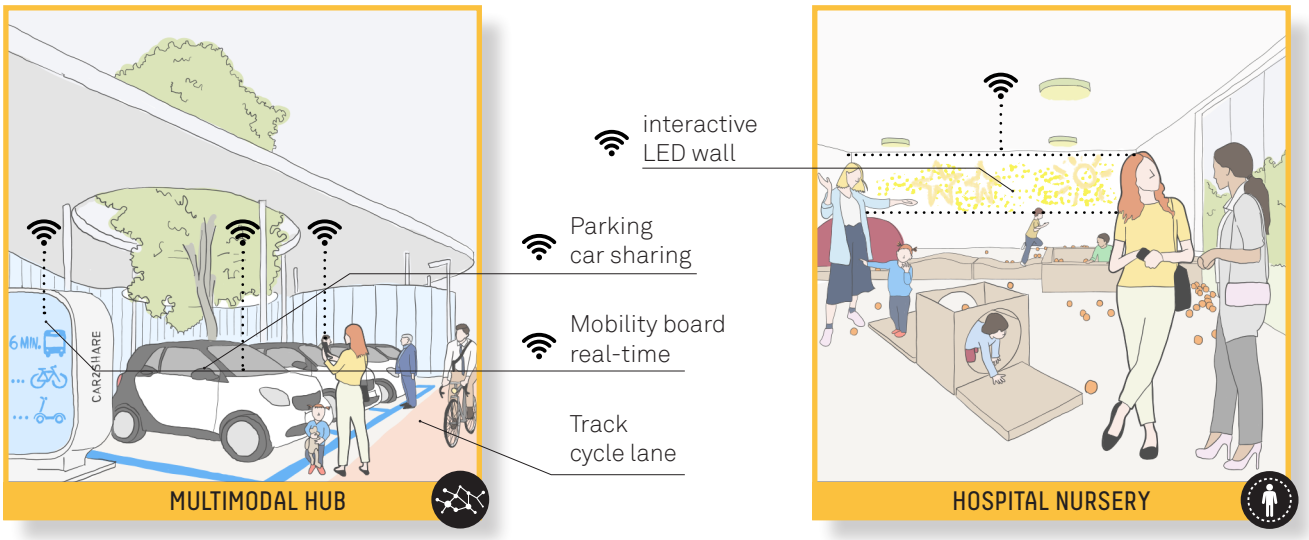
Critical issues in the experience

- Difficulties in reaching the workplace;
- Lack of digitisation of processes;
- Difficulties in managing family life;
- Lack of time to study.

TYPICAL WORKING DAY

AFTERNOON		EVENING	
5 | MEETING WITH TUTOR	**6 | END OF DAY**	**7 | BACK HOME**	**8 | FREE TIME**
• Meet with tutor to discuss plans for patients; • End of advanced work in the morning.	• Discussion of the evening plan with the nurses on duty; • End of shift and return to home.	• Travel by bus to pick up the child from kindergarten; • Routine shopping and errands; • I go back home.	• Evening study of the specialist subject.
• Inability to update data in real time.	• Lack of family assistance (babysitting).	• Waste of time traveling, with no choice of transport; • Free time spent	• lack of free time; • Lack of time to devote to study; • Physical and mental tiredness.

Staff journey - tomorrow
Resident internist



PHASES				
TIMING	MORNING			
STEPS OF THE JOURNEY	1 | ACCESS	2 | ORGANIZATION	3 | VISITS	4 | LUNCH BREAK
SATISFACTION WITH THE EXPERIENCE				
ACTIONS	• Departure from home at 6.30; • Car sharing trip; • Dedicated parking in the structure; • Accompaniment of the child to the kindergarten to the hospital.	• Entrance to the ward/clinic and meeting with nurses; • Electronic medical records updated in real-time.	• Visit of patients with the specialist / meeting of outpatients independently. (number of patients on reduced shifts).	• Lunch break at the restaurant in the park; • Possible remote lesson/seminar. • Rest in nap room.
CRITICAL ISSUES	• Reduction of travel thanks to the family assistance structure within the workplace.	• Ease and precision in updating the patient's clinical situation without loss of information.	• Optimal number of patients to dedicate the necessary time and care to each one.	• Lunch break in a place of relaxation and disconnection.
TOUCHPOINT	Hospital Neighborhood hubs Home / remote			

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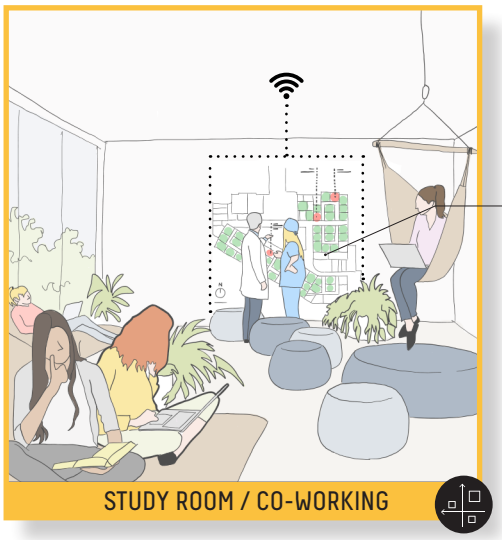

Real-time billboard

Smart market

Cultivation Hydroponics

TYPICAL WORKING DAY

AFTERNOON		EVENING	
5 | MEETING WITH TUTOR	**6 | END OF DAY**	**7 | BACK HOME**	**8 | FREE TIME**
• Meet with tutor to discuss plans for patients; • Termination of work; • Electronic updating of the clinical picture of patients.	• Discussion of the evening plan with the nurses on duty; • End of shift; • Afternoon study in the study room / hospital library.	• Shopping at the food bank in the hospital grounds; • Return home with car sharing with the little girl.	• Streaming viewing of the show organized in the hospital park.
• Ease and precision in updating the patient's clinical situation without loss of information.	• Possibility to use the auxiliary services of the hospital for personal purposes, during the free hours of the day.	• Optimization of commissions thanks to the wide choice of services and on-site points of sale; • Multimodality of means of transport.	• Moments of leisure and evening entertainment on site or at home.

5 Notes and credits

Notes

2 | Vision and objectives

The hospital as a network

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Patient Journey

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Preface

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Introduction

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Context

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Vision and objectives

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Design guidelines

Östra Psychiatry Hospital, White Arkitekter, Visuals by: Christer Hallgren
Sayanomoto clinic,Yamazaki Kentaro design workshop / Kentaro 96
Yamazaki, Photo by: Naoomi Kurozumi 97
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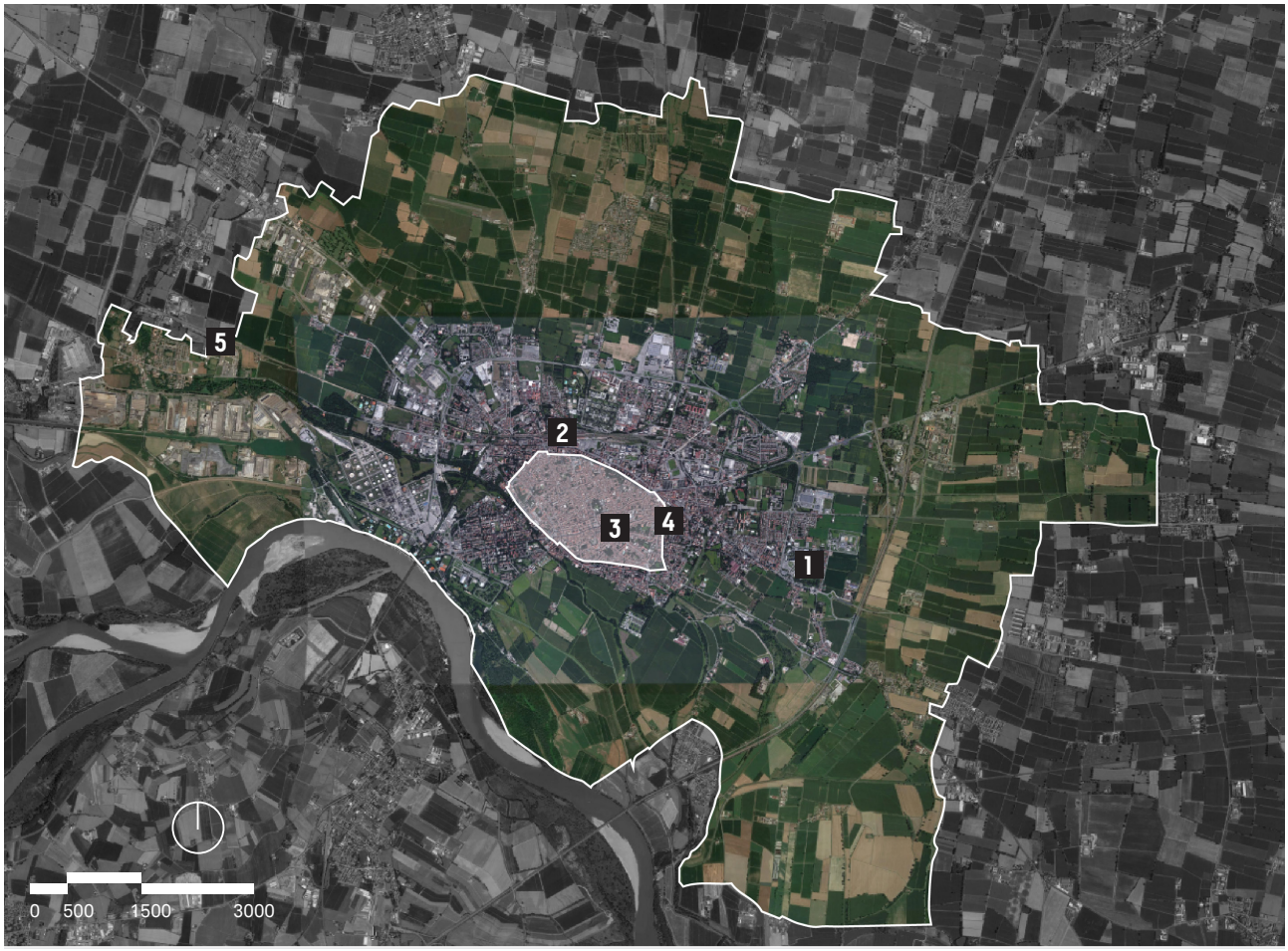
Agnelli Foundation 3.0, CRA-Carlo Ratti Associati, Photo by: Beppe Giardino 118

6 Appendix

Hospital of Cremona
project site

FIG. 17 *Hospital Location of the hospital in relation to the city of Cremonadale di Cremona*



1 Hospital of Cremona
2 Central Station
3 Cathedral
4 Bastions
5 Municipality

FIG. 18 *Project area, single block building and pavilions.*

1 **Hospital of Cremona**
area: sqm 17.000

2 **Administration**
area: sqm 860

3 **Schools**
area: sqm 970

4 **Pathological anatomy**
sarea: sqm 850

5 **Thermal plant**
area: sqm 1000

6 **Lavanderia**
area: sqm 1150

7 **Infectious**
area: sqm 2000

8 **Hospice**
area: sqm 500

9 **Offices**
area: sqm 700

10 **Psychiatric services**
area: sqm 500

11 **Pharmacy**
area: sqm 200

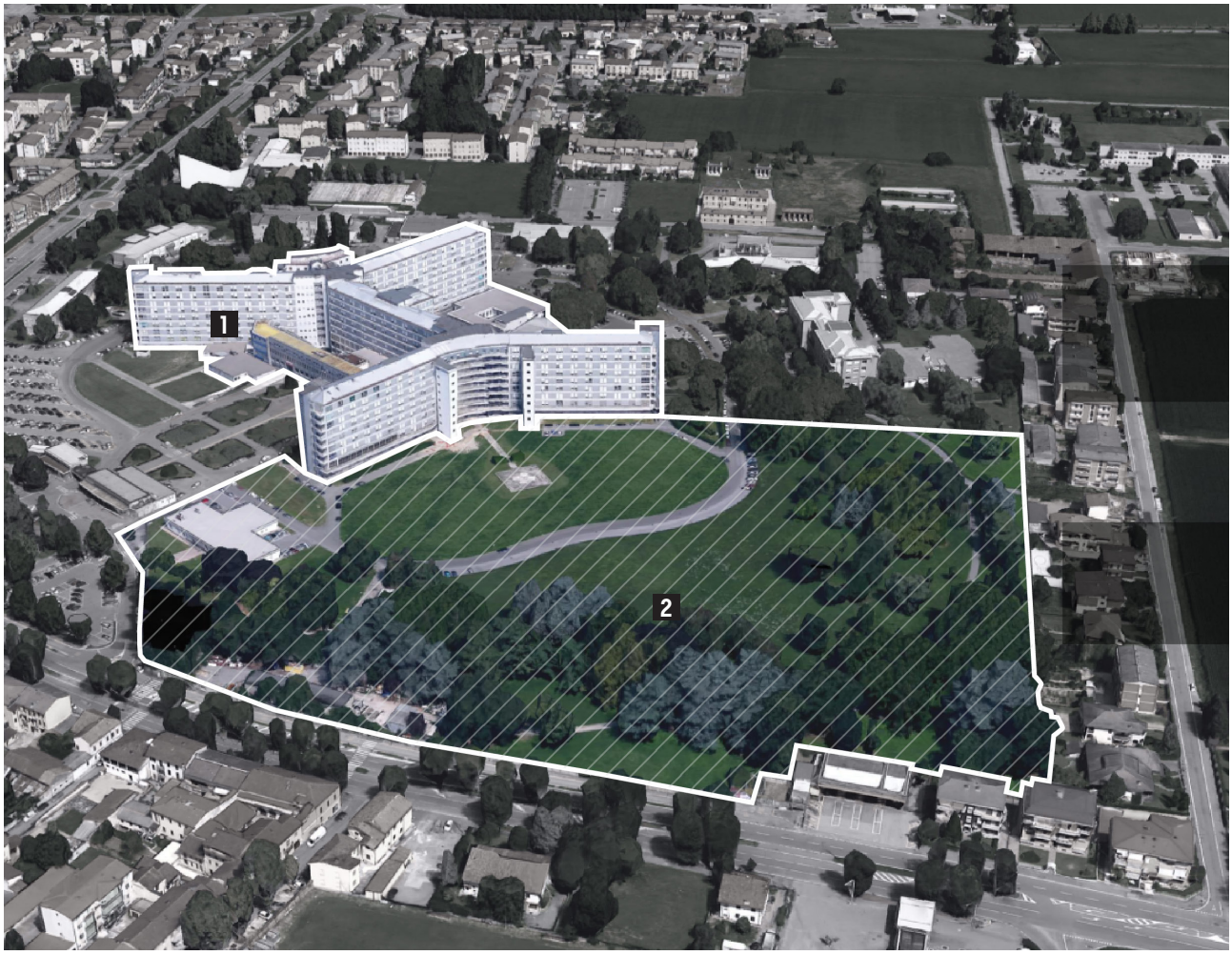
12 **Concierge**
area: sqm 680

13 **Reservation Center**
area: sqm 1000

14 **Project site**

Hospital of Cremona
project site

FIG. 19 *Identification of the project area within the lot*



1 Current Hospital of Cremona

2 Project area for the New Hospital

FIG. 20 *Identification of demolishable buildings and relocatable functions*

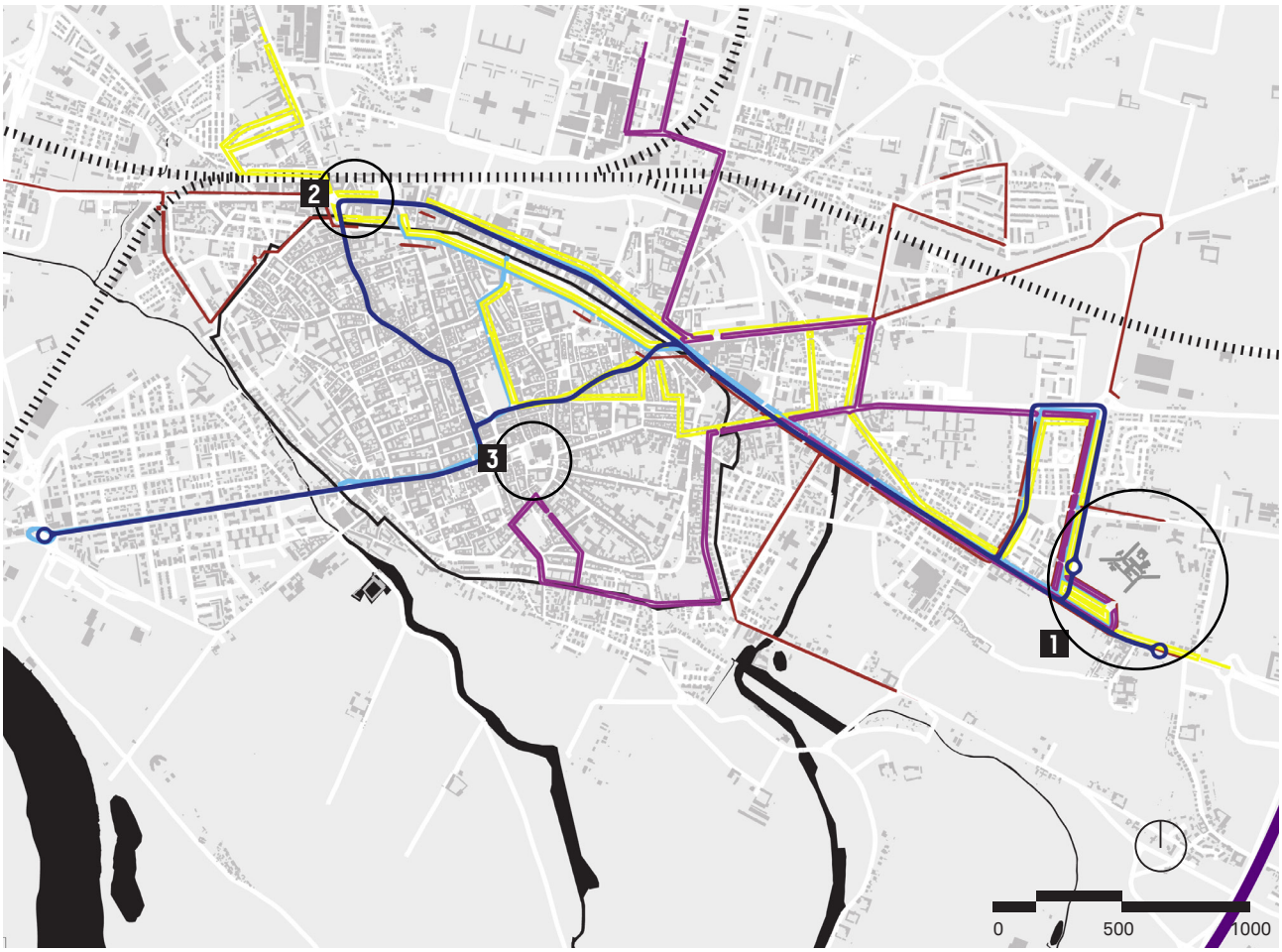
1 Border of the hospital unit lot

Demolishable buildings

Buildings that can be demolished following the relocation of functions within the Hospital unit lot

Framework
public transport

FIG. 21 *Rail, highway and bus transport system (web data)*



1 **Hospital of Cremona** project site

2 Central Station

3 Cathedral

Bus line - G

Bus line - D

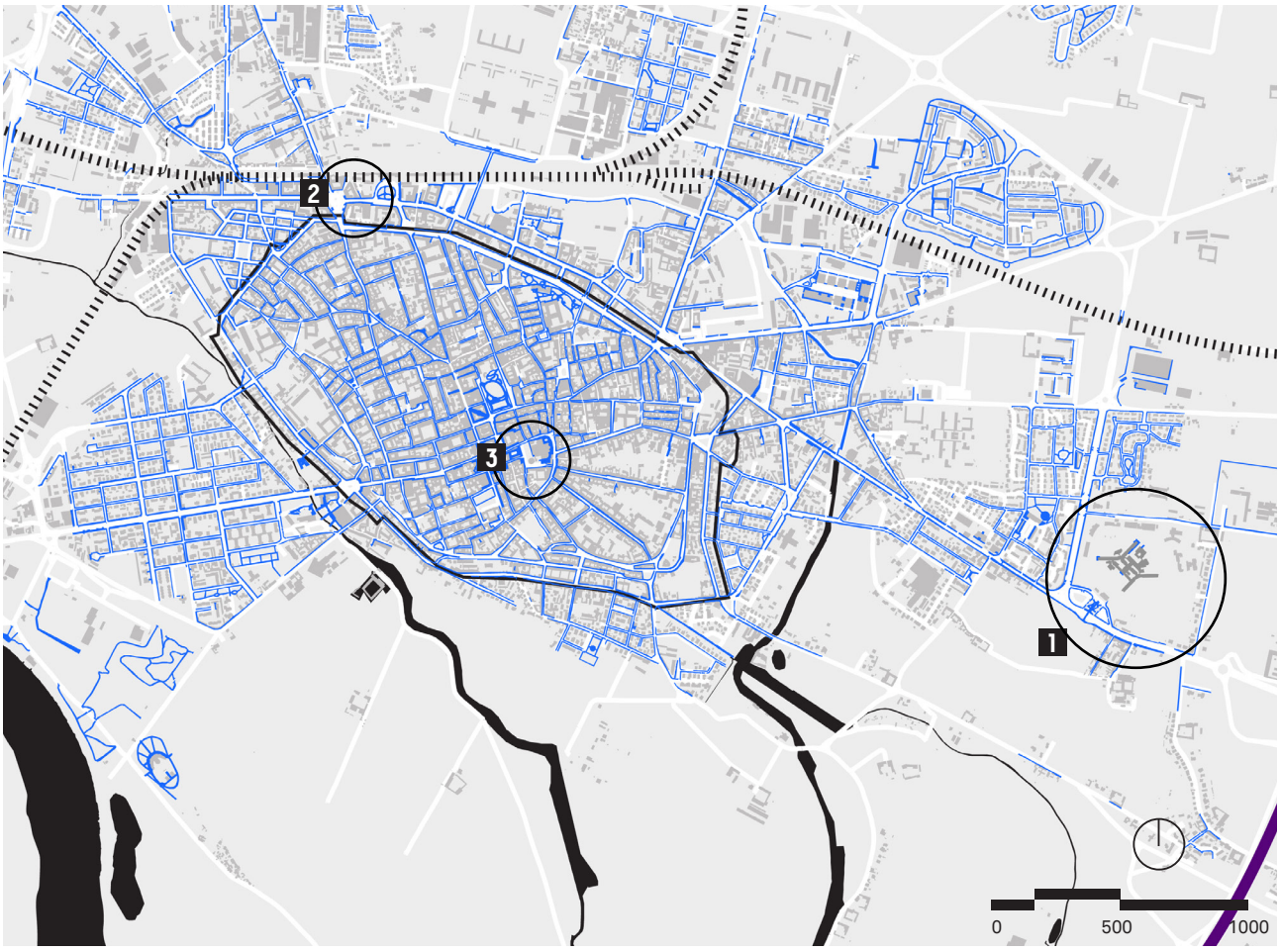
Bus line - M

Bus line - E

FIG. 22 *Connection to project site (web data)*

Framework
cycle path and pedestrian flows

FIG. 23 *Cycling infrastructure (web data)*



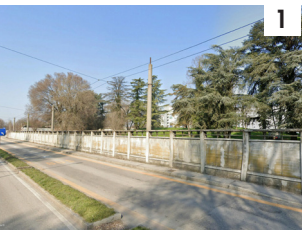
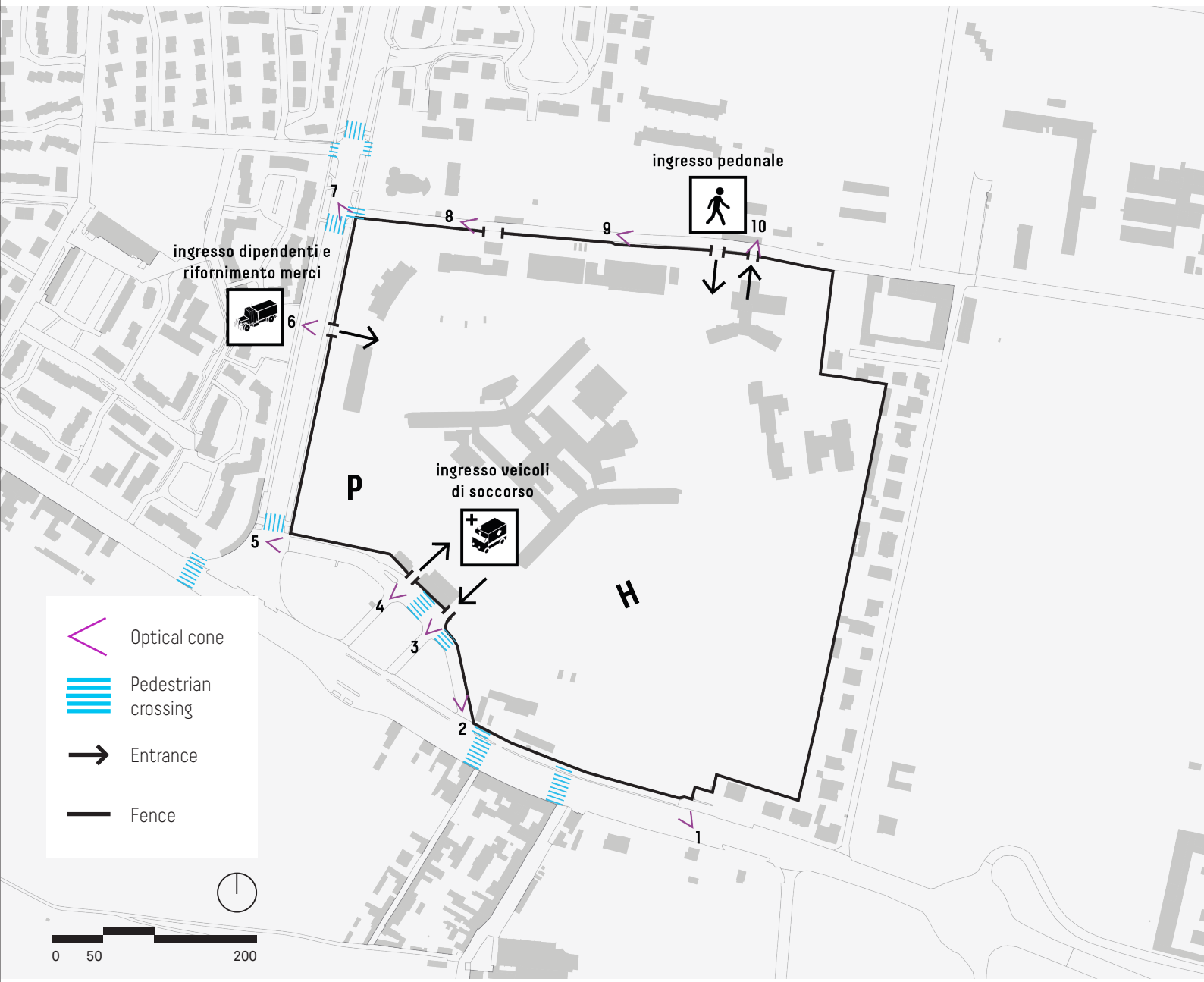


FIG. 24 *Access to the project site*



Framework
territorial and site green areas

FIG. 25 *System of green areas pertaining to and surrounding the Cremona Hospital (web data)*

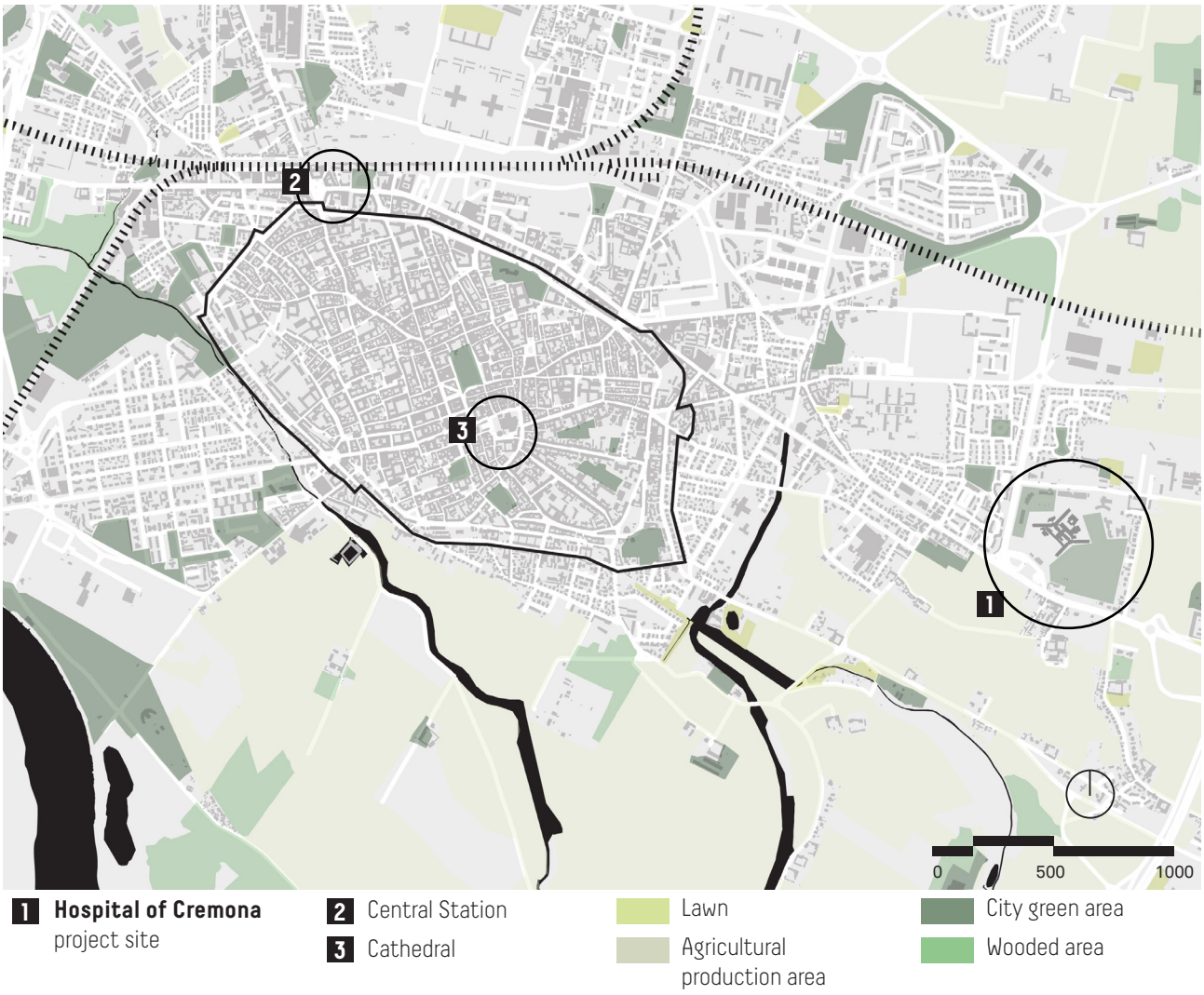
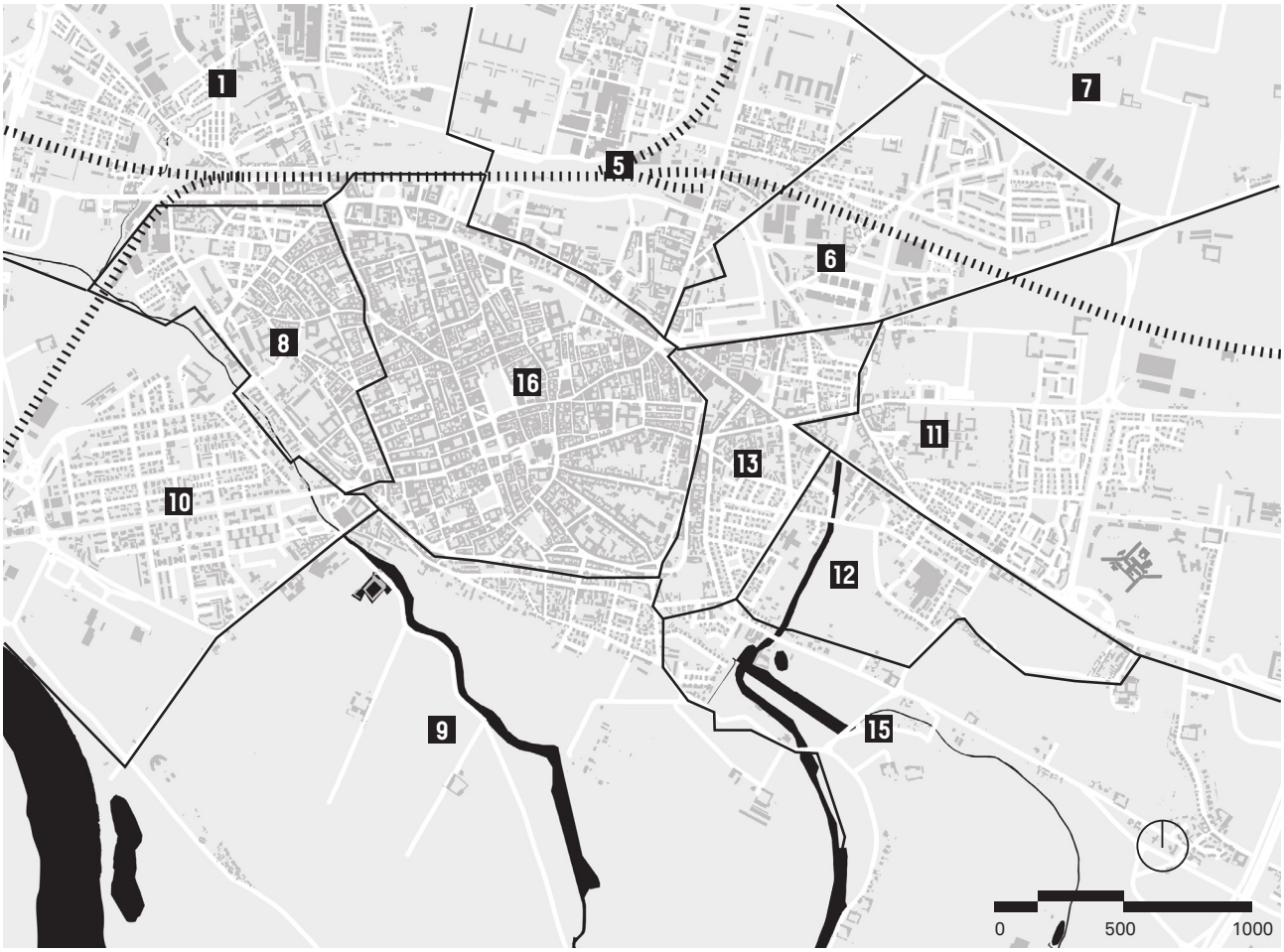


FIG. 26 *Characterization of vegetation inside and outside the lot (Piano Territoriale di Coordinamento Provinciale - PTCP)*

Framework
land use

FIG. 27 *Municipality of Cremona, subdivision by neighborhood committees (Open data, Lombardy Region)*



1 Risorgimento-S. Ambrogio-Incrociatello-Via Sesto

2 Boschetto-MIgliaro

3 Cavatigozzi -S.Predengo

4 Cambonino

5 Borgo Loreto-S.Bernardo-Naviglio

6 Zaist-Stadio-Lucchini-Annona

7 Maristella

8 Castello

9 Giordano-Cadore

10 Po-Parco-Canottieri-Trebbia

11 Cascinetto-Villetta-Concordia

12 Novati

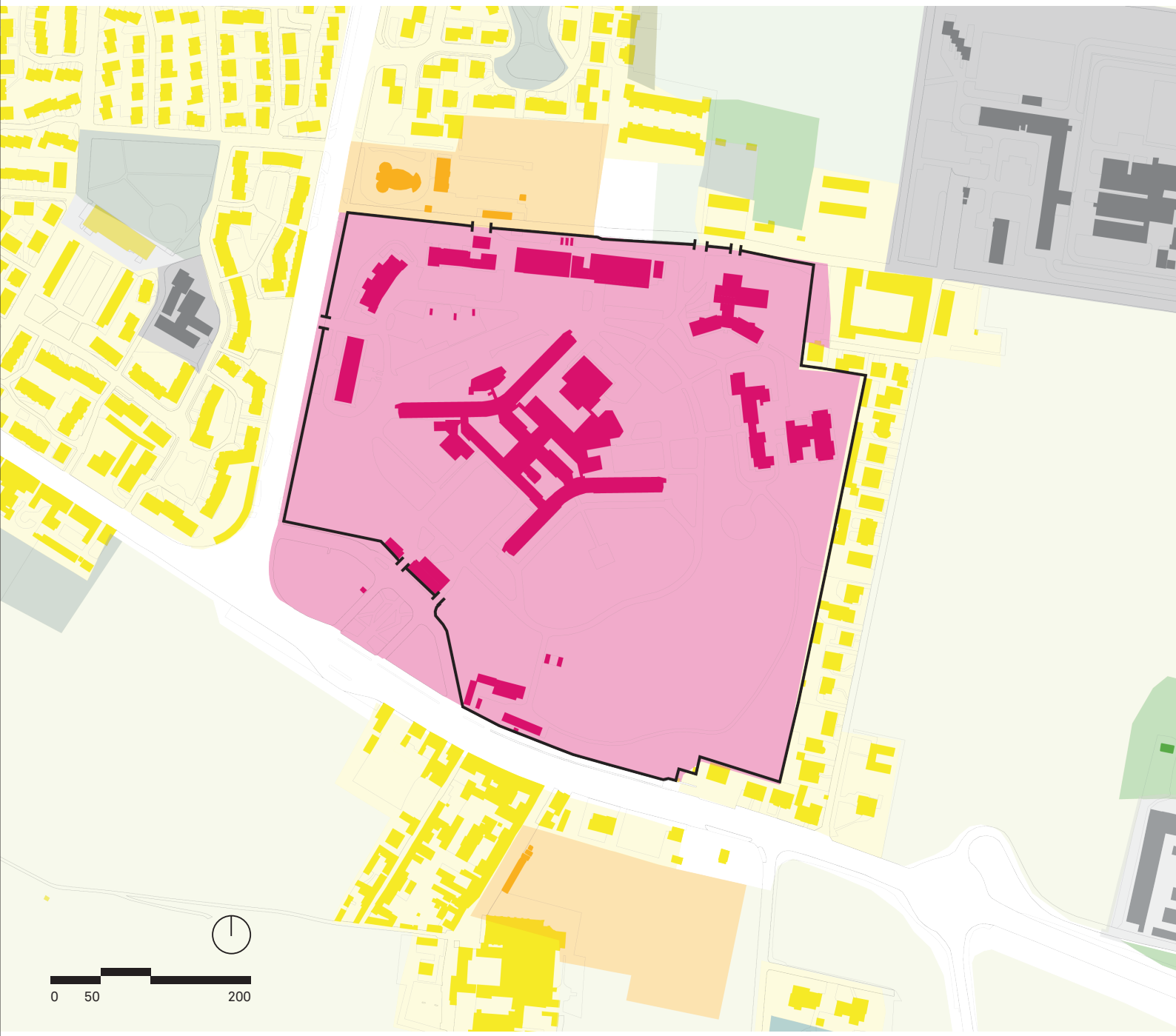
13 Porta Romana-Largo Pagliari

14 San Felice-S.Savino

15 Bagnara-Battaglione-Gerre Borghi

16 Centro

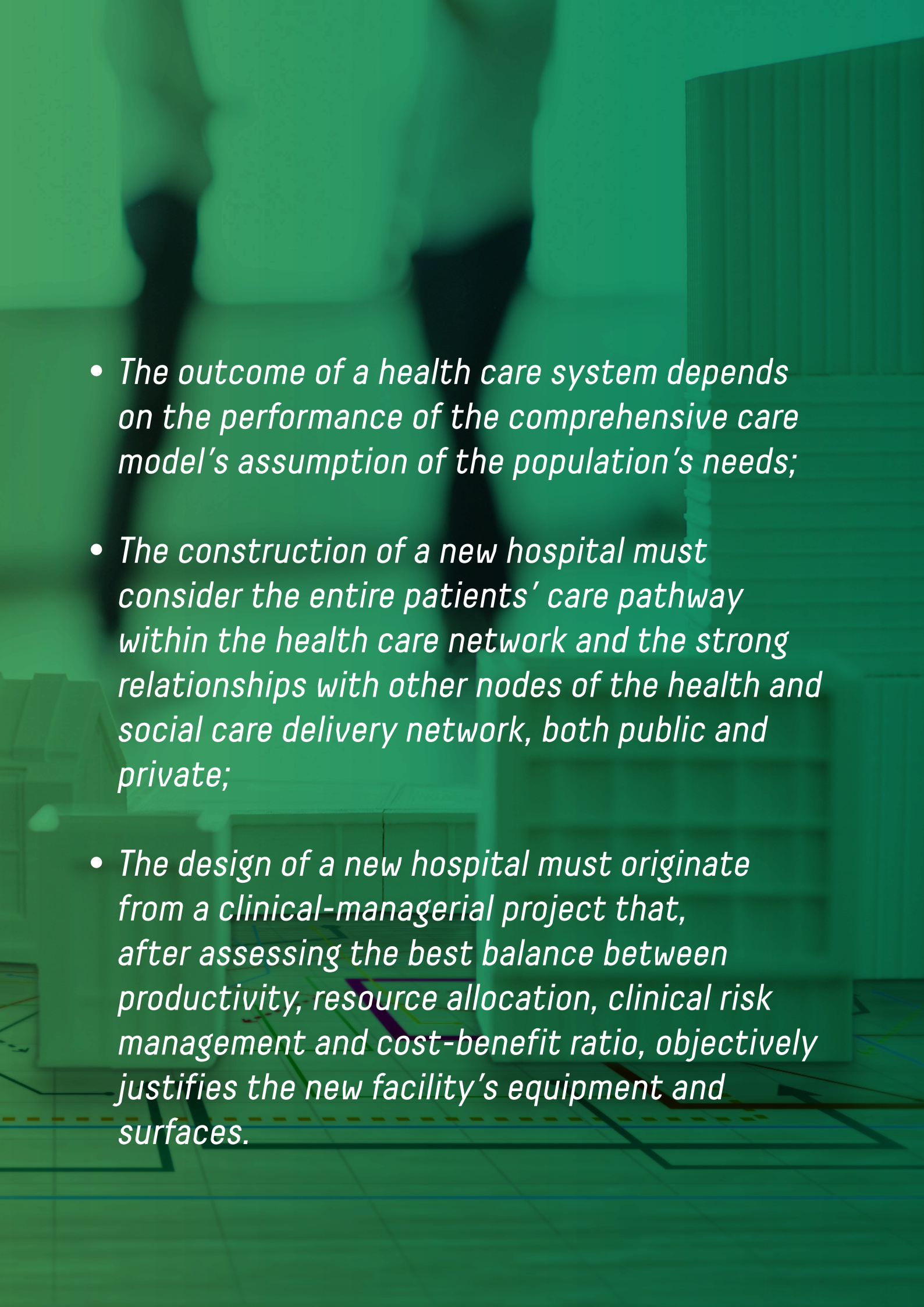
FIG. 28 *Dusaf 6.0 - Land use and land cover 2018 (Lombardy Region Geoportal)*



Part 2
Requirements

The design of a new hospital must be conceived starting with the scientific definition of the demanding framework of the pertaining health network.

Clinical-Managerial Dimensioning



- *The outcome of a health care system depends on the performance of the comprehensive care model's assumption of the population's needs;*

- *The construction of a new hospital must consider the entire patients' care pathway within the health care network and the strong relationships with other nodes of the health and social care delivery network, both public and private;*

- *The design of a new hospital must originate from a clinical-managerial project that, after assessing the best balance between productivity, resource allocation, clinical risk management and cost-benefit ratio, objectively justifies the new facility's equipment and surfaces.*

1 Equipment

The New Hospital
as an opportunity to reorganise the network

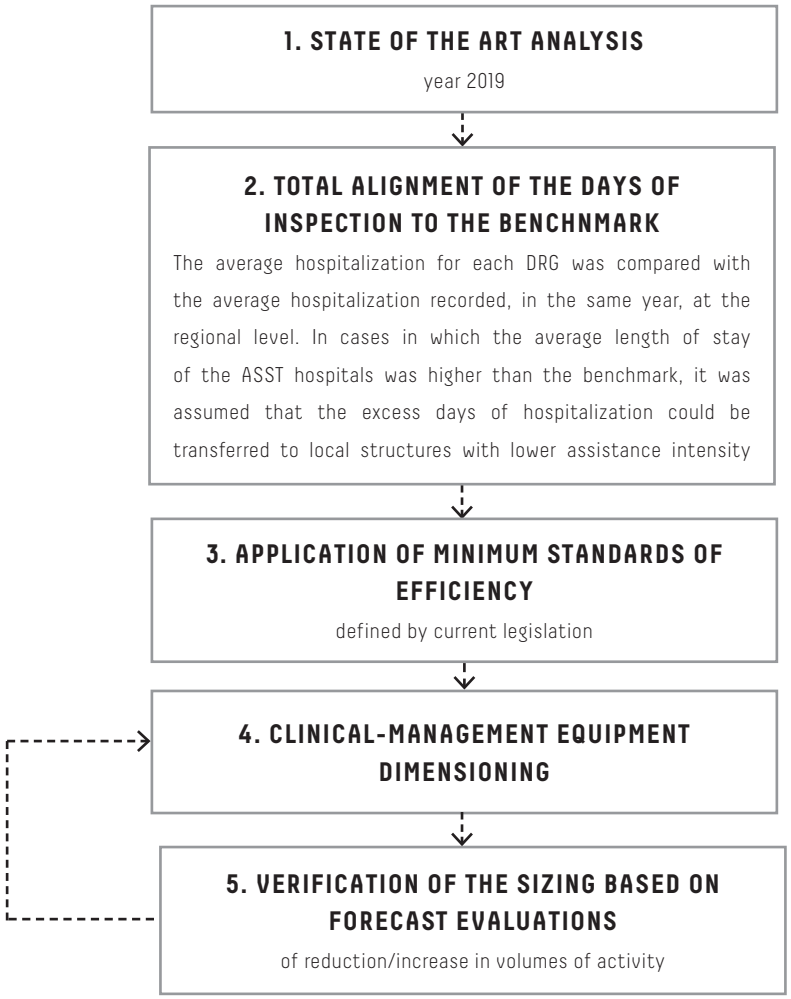
Healthcare network efficiency

The construction of the New Hospital in Cremona is part of a project to **reorganise the entire hospital network of the Cremona ASST**, which aims to optimise the use of acute-care beds.

In this regard, a reorganisation of the ASST's hospital beds is envisaged to rebalance the distribution of resources across the various activity areas and address the population's actual requirements.

CLINICAL-MANAGEMENT DIMENSIONING
The clinical-management project of the New Hospital in Cremona defines the new organisational and technical-functional configuration of the new hospital aiming to return to the region a hospital structure that is effective and efficient in its role of overseeing and providing care, while capable of ensuring high quality levels of intervention and relate with more specificity to the social context in which the future structure will be inserted. For further details, please refer to the document "*Relazione clinico gestionale*".

FIG. 29 *Methodological path for the reorganization of the Cremona ASST network*



Efficiency enhancement in acute wards

By use of inpatient activity data for the year 2019, the number of inpatient days provided by acute hospital wards, and possibly transferable to regional facilities with lower care intensity, were estimated.

The evaluation interested ordinary admissions to the Medical Area (excluding Infectious Diseases), the Psychiatric Area and the Surgical Area; paediatric admissions were excluded from the evaluation.
In total, 24,685 days of hospitalisation in the Cremona ASST units can potentially be transferred across the region, comprising 17,822 days in the Cremona Hospital and 6,863 days in the Oglio Po' Hospital.

It is therefore necessary to **include 80 non-hospital beds within the relevant supply network**, such as strategic equipment for the proactive care and management of chronic and frailty-related pathways, in synergy with acute-care hospitals.

TAB. 1 *Ordinary hospitalization and day-hospital facilities and activities and indication of transferable days of hospitalization on the territory*

CREMONA HOSPITAL	PL RO	GG RO	DM RO	GG TERR	GG OTT	PL DH	ACC DH
MEDICAL AREA	198	69.309	8,9	14.558	62.030	4	714
SURGICAL AREA	136	33.315	7,3	1.918	33.746	11	1.686
MATERNAL-INFANT AREA	58	13.810	5,4	0	12.404	2	513
PSYCHIATRIC AREA	15	4.753	10,5	1.347	4.080	0	0
INTENSIVE AREA	8	2.326	6,1	0	2.326	0	0
NON-ACCUZIA AREA	36	10.754	30	0	10.754	0	0
DIAGNOSTIC AREA	14	3.313	19,4	0	3.313	0	36
TOTAL	***465***	***137.580***	***8,5***	***17.822***	***128.653***	***17***	***2.949***

OGLIO PO' HOSPITAL	PL RO	GG RO	DM RO	GG TERR	GG OTT	PL DH	ACC DH
MEDICAL AREA	52	21.725	10,2	5.770	18.840	1	0
SURGICAL AREA	37	6.393	5,5	260	6.263	5	830
MATERNAL-INFANT AREA	10	1.063	4,4	0	1.063	3	13
PSYCHIATRIC AREA	10	3.309	12,7	833	2.893	0	0
INTENSIVE AREA	8	774	9,3	0	774	0	0
NON-ACCUZIA AREA	4	0	0	0	0	0	0
TOTAL	***121***	***33.264***	***8,6***	***6.863***	***29.832***	***9***	***843***

Source: ASST Cremona data processing, year 2019
RO: Ricovero Ordinario (Ordinary Hospitalization) - GG: Giornate degenza (Days of hospitalization) - DM: Degenza media (Average stay) - GG TERR: Giornate degenza trasferibili sul territorio (Days of hospitalization transferable on the territory) GG OTT: Giornate degenza ottimizzate (Optimized days of hospitalization) - DH: Day-Hospital - ACC: Accessi (Accesses)

The macro-pathways of the New Hospital

Reorganisation of hospital activities

The construction of the New Hospital in Cremona is an opportunity to **reorganise the hospital's activities in order to favour patient-centredness**, optimisation of hospitalisation flows and both efficient and effective management of the heterogeneity and complexity of the services provided in the hospital.

The clinical-managerial dimensioning of the healthcare functions of the New Hospital was therefore developed according to a model organised on **8 macro-pathways**, identified in relation to the type of patient and their possible clinical course.

FIG. 30 *Macro-pathways of the New Hospital of Cremona*

TRAUMA - URGENCY - EMERGENCY

The trauma-urgency-emergency pathway is dedicated to cardiological and neurological activity, often related to the treatment of time-dependent pathologies and the use of high-level care functions (UTIC, haemodynamics, etc.). This path also includes the activity of infectious diseases and the ordinary activity in an emergency regime.

SENESCENCE

The senescence pathway concentrates most of the activities of general medicine, pulmonology and nephrology, characterized by a medium-high intensity and addressed to elderly patients and in multi-chronic conditions.

ELECTIVE SURGERY

The elective surgery pathway is dedicated exclusively to scheduled ordinary activity (oncological and otherwise) with hospitalization greater than or equal to 5 days.

ONCOLOGICAL

The oncological pathway is dedicated to the assistance of oncological patients and includes the main functions required for the overall management of the tumor pathology during the stages of diagnosis, staging, treatment and follow-up.

LOW COMPLEXITY

The low complexity pathway is dedicated to low-intensity surgical assistance, in a week-surgery regimen (hospitalisation <5 days) or in a day regimen (day hospital or outpatient clinic).

MOM-CHILD

The mother-child pathway includes all maternal-neonatal and pediatric assistance.

REHABILITATION

The rehabilitation pathway is intended for medium and high intensity post-acute care.

MENTAL HEALTH

The mental health pathway is dedicated to patients of the psychiatry service.

Hospitalizations of the New Hospital

The dimensioning of inpatient activity

On the basis of the identified model, for each inpatient activity, the current productivity levels were analysed, the extent of efficiency gains and performance improvements were assessed, and the necessary equipment for each service was identified with a view to re-engineering, optimisation and compliance with the prescriptive standards laid down by regulatory provisions.

The New Hospital envisages a total of 445 beds, 6 surgical low intensity (BIC) places and 42 intensive multiple-treatment outpatient pathway (MAC) places.

The endowments defined will make it possible to provide current admissions and to manage an increase in the number of days of hospitalisation in view of the **increase in the demand for admissions** related to the ageing of the hospital's catchment area, the **recovery of part of the admissions in passive mobility**, the increase in the volume of activities resulting from the **inclusion in the New Hospital of highly complex specialities** and the greater attractiveness. The equipment is also adequate for the possible **recognition of the hospital's role as a level II Emergency and Admission Department (DEA).**

TAB. 2 *Overall hospitalization facilities for the New Cremona Hospital*

MACRO-PATHWAY	AREA	ORDINARY PL	DAY-HOSPITAL PL	BIC PLACES	MAC PLACES
TRAUMA - URGENCY - EMERGENCY	MEDICAL	58			
	SURGICAL	41			
	INTENSIVE	28			
	SUBTOTAL	***127***			
SENESCENCE	MEDICAL	94	2		
	SUBTOTAL	***94***	***2***		
ELECTIVE SURGERY	SURGICAL	59			
	SUBTOTAL	***59***			
ONCOLOGICAL	MEDICAL	21			33
	SUBTOTAL	***21***			***33***
LOW COMPLEXITY	MEDICAL	21			9
	SURGICAL	21	8	6	
	SUBTOTAL	***42***	***8***	***6***	***9***
MOM-CHILD	OBSTETRIC	24			
	PEDIATRIC AND INTENSIVE	23			
	SUBTOTAL	***47***			
REHABILITATION	REHABILITATION	34			
	SUBTOTAL	***34***			
MENTAL HEALTH	PSYCHIATRIC SERVICE	11			
	SUBTOTAL	***11***			
	TOTAL	***435***	***10***	***6***	***42***

PL: Posti Letto (Beds)

Services of the New Hospital

The dimensioning of health services

Based on the analysis of the current forecast activity levels of the health services offered at the Cremona Hospital, the efficiency recoveries and performance improvements that can be pursued were assessed with the aim of identifying the best optimisation and efficiency enhancement scenario in view of the re-engineering and renewal of the hospital's services. The planned allocations will therefore allow **the current productivity volumes to be delivered** and a possible increase in activity to be managed to allow for the **partial recovery of passive mobility**.

Emergency-urgency area

The emergency-urgency area of the New Hospital comprises three sub-areas: Emergency Department, Short-stay observation (OBI), A&E diagnostics.
The Emergency Department consists of 2 triage boxes, 4 high intensity boxes, 18 medium-low intensity boxes, 1 white code box, 1 isolated box, 2 paediatric boxes and 6 specialist units (2 orthopaedic boxes, 1 plaster room, 1 psychiatric box, 1 small surgery box, 1 pink code box). Diagnostics dedicated to the A&E include 2 x-ray rooms, 1 CT room and 1 ultrasound room.
The short-stay observation (OBI) comprises 12 technical posts and 1 discharge room area.

Operating and interventional blocks

In the operating area of the New Hospital, a total of 15 operating theatres are planned: 8 theatres for ordinary major surgery (of which 1 hybrid), 2 theatres for emergency-urgency activity (of which 1 hybrid) and 5 theatres for minor surgery (Day Hospital, low intensity surgery (BIC), outpatient).
The interventional area consists of 1 haemodynamics room, 1 electrophysiology room, 1 interventional radiology room and 1 interventional neuroradiology room.

Endoscopy service

The New Hospital's endoscopy plate includes 3 digestive endoscopy rooms, 1 urology endoscopy room and 1 thoracic endoscopy room.

Birthplace and obstetrical ER

The birthplace consists of 3 labour and delivery rooms and 1 caesarean section room. The obstetrical ER includes 1 triage box, 2 examination rooms and 1 cardiotocographic monitoring area.

Radiology

In the New Hospital Imaging Diagnostics, 13 diagnostic rooms are planned: 3 x-ray rooms, 3 CT rooms, 2 MRI rooms, 3 ultrasound rooms and 2 rooms equipped with mammography equipment.

Radiotherapy

The radiotherapy service is equipped with 3 bunkers, 1 CT-simulator and 1 brachytherapy room.

Nuclear medicine

The nuclear medicine service is equipped with 2 SPECT rooms, 1 PET-CT room and 1 MOC room.

Outpatient Clinic

In the outpatient area of the New Hospital, a total of 135 outpatient clinics are planned (including ultrasound rooms, gyms, therapy cubicles, etc.), of which 102 for the medical-surgical area, 9 for the maternal-infant and paediatric area, 14 for the rehabilitation area, 2 for psychiatry, 4 for radiotherapy and nuclear medicine, and 4 for pre-hospitalisation.

Donor and Transfusion Centre

The donor and transfusion centre consists of a total of 16 donation and treatment stations.

Dialysis

The dialysis service comprises 34 stations.

2 Functional Programmes

Functional Programmes of the New Hospital

Spatial dimensioning

On the basis of the clinical-managerial dimensioning obtained for the New Hospital, the **functional programme** was developed, which defines the areas required for each Homogeneous Functional Area (HFO) - healthcare and support - within the hospital. To this end - by cross-referencing the specifications of **national and regional accreditation regulations** with information from **national and other best-practice** and **design experiences** - a precise list is drawn up of all the types of rooms and spaces that must be provided in each HFO in order to guarantee the efficient management and operation of the department, as defined and characterised by the functional dimensioning.

TAB. 3 *Overall equipment of the New Cremona Hospital and functional macro-area surfaces (follows next page)*

MACRO-AREA	FUNCTIONAL AREA	SQM	PL RO	PL DH	PT BIC	PT MAC	PT	EQUIP-MENT	DIMENSIONING DETAILS
MOM-CHILD	OBSTETRICS WARD	6.200	24				15		24 PL (100% single room) - 15 NEONATAL COTS
	NEONATAL PATHOLOGY		10						10 PL
	NEONATAL ICU		4						4 PL
	MATERNITY BLOCK							4	3 LABOR AND DELIVERY ROOMS - 1 C-SECTIONS ROOM
	OBSTETRICS ER							4	1 BOX TRIAGE - 2 CLINICS - 1 CARDIOTOCOGRAPHY AREA
	OBSTETRICS CLINICS							7	7 CLINICS AND GYMS
	PEDIATRIC WARD		9						9 PL (100% single room)
	PEDIATRIC CLINIC							2	2 CLINICS
TRAUMA - URGENCY - EMERGENCY	DEA	3.200					12	39	2 BOX TRIAGE - 4 BOX AI - 18 BOX MI - 2 BOX PEDIATRIC - 1 BOX WHITE CODES- 1 BOX ISO - 6 BOX SPECIALIST - 12 PT O.B.I. - 1 DISCHARGE ROOM - 2 RX - 1 TC - 1 ECO
	MEDICAL WARD	10.600	58						58 PL (100% single room)
	SURGICAL WARD		41						41 PL (100% single room)
	INTENSIVE WARD		28						28 PL
ELECTIVE SURGERY	SURGICAL WARD	4.400	59						59 PL (100% single room)
INTERVENTIONAL AREA	OPERATING BLOCK	6.200						15	8 ROOMS MAJOR SUR. - 2 SOP. EMERGENCY (OF WHICH 1 SOP. HYBRID) - 5 SOP. MINOR SUR.
	INTERVENTIONAL BLOCK							4	1 HEMODYNAMICS ROOM - 1 ELECTROPHYSIOLOGY ROOM- 1 SALA INTERVENTIONAL RADIOLOGY - 1 SALA NEURORADIOLOGY INT.
	ENDOSCOPY							5	3 ROOMS DIGESTIVE ENDO. - 1 ROOM UROLOGY - 1 ROOM ENDO. THORACIC
ONCOLOGICAL	MEDICAL WARD	5.500	21			33			21 PL (100% single room) - 33 PT MAC
	NUCLEAR MEDICINE							5	2 SPECT - 1 MOC - 1 PET-TC - 1 CLINIC
	RADIOTHERAPY							8	3 ACC. LINEAR - 1 TC-SIMULATOR - 1 ROOM BRACHYTHERAPY - 3 CLINICS
SENESCENCE	MEDICAL WARD	6.300	94	2					94 PL (100% single room) - 2 PL DAYTIME
REHABILITATION	REHABILITATION WARD	3.400	34						34 PL (100% single room)
	OUTPATIENT AREA							14	14 CLINICS AND GYMS
MENTAL HEALTH	PSYCHIATRIC WARD	900	11					2	11 PL (100% single room) - 2 CLINICS

RO: Ricovero Ordinario (Ordinary Hospitalization) - PL: Posti Letto (Beds) - PT: Posti Tecnici (Technical Seats) - DH: Day-Hospital

Considering specific dimensional parameters for each HFO - deduced from the analysis of hospital projects on various scales - the net area is related to the gross area (ward connectives, technical rooms, wall incidence), thus determining the total area for each macro-functional area (MFO) or macro-pathway.

The total gross floor area for the New Cremona Hospital has thus been estimated at approx. 99,500 square metres, corresponding to 179.6* square metres/technical bed.

MACRO-AREA	FUNCTIONAL AREA	SQM	PL RO	PL DH	PT BIC	PT MAC	PT	EQUIP-MENT	DIMENSIONING DETAILS
LOW COMPLEXITY	MEDICAL WARD	3.700	21			9			21 PL (100% single room) - 9 PT MAC
	SURGICAL WARD		21	8	6				21 PL (100% single room) - 8 PL DAYTIME - 6 PT BIC
DAYTIME HOSPITAL	RADIOLOGY	7.700						13	3 RX - 3 TC - 2 RM - 3 ECO - 2 MAMMO
	OUTPATIENT AREA							106	4 CLINICS PRE-HOSPITALIZATION -102 CLINICS MEDICAL AND SURGICAL AREA
	DIALYSIS						34		34 PT DYALISIS
HEALTH SERVICES AREA	PHARMACY	4.800							
	STERILIZZATION								
	ANALYSIS LAB.								
	TRASF. CENTER							16	16 PLACES DONATIONS AND THERAPY
	MORGUE								
PERSONNEL AREA	OFFICES, MED. STUDIES	12.600							
	ADMIN. OFFICES								
	CHANGING ROOMS								
USERS AREA	ENTRANCE	2.500							
	CANTEEN								
	RETAIL SPACES								
GENERAL SERVICES AREA	HOUSE KEEPING	5.500							
	TECHNOLOGY								
	WORKSHOPS								
	WAREHOUSE								
	KITCHEN								
CONNECTIONS	GENERAL CONNECTIONS	16.000							

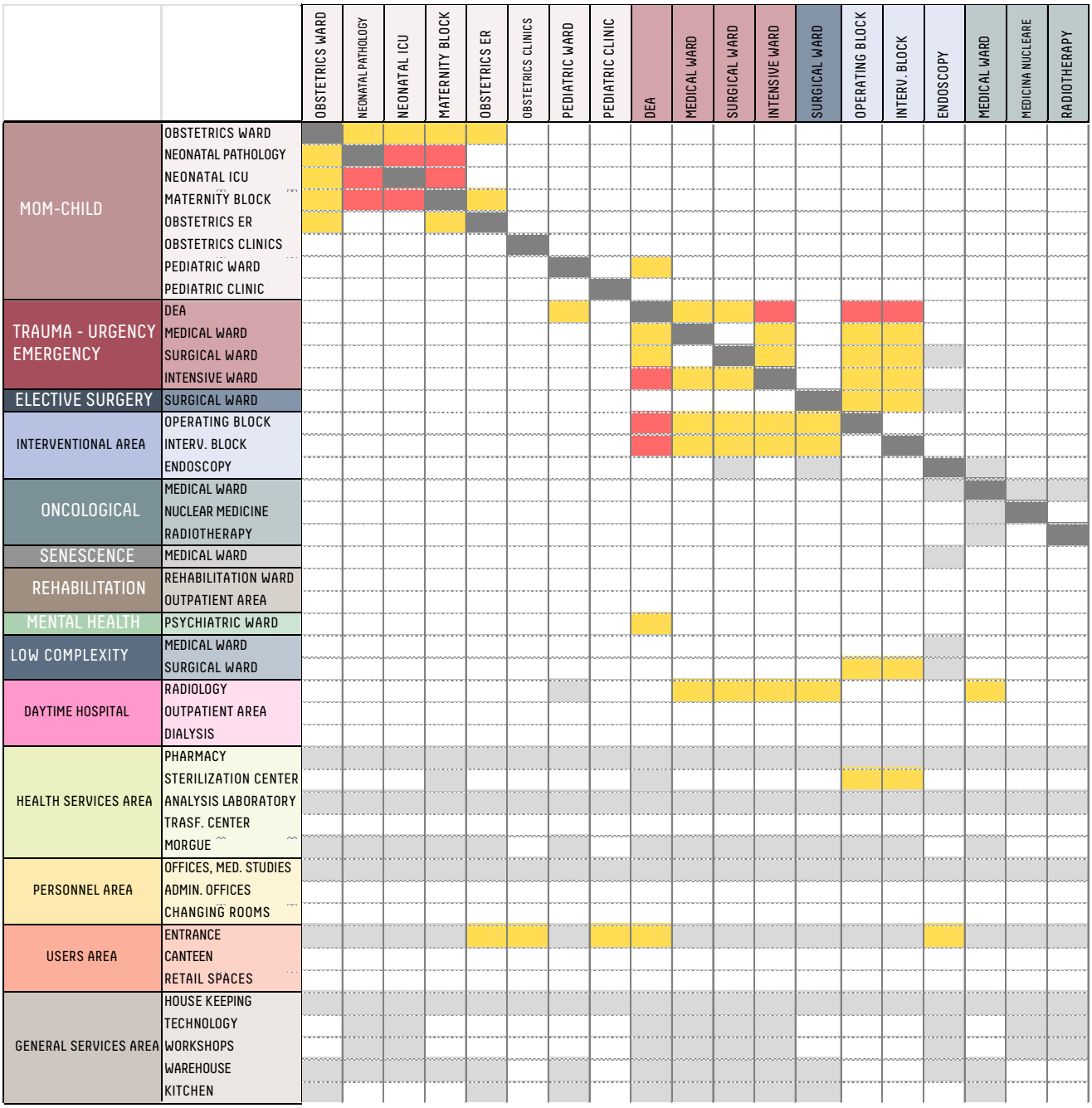
**The higher value compared to the benchmarks of similar new healthcare facilities in terms of functional areas and equipment results from the fact that all ordinary beds are in* single and double inpatient rooms.
This feature constitutes a constraint as well as a strength of the project and will guarantee, in addition to increased hotel comfort for patients, future flexibility in the event that more beds are needed than planned in the design phase.

3 Functional relationships

The Relationship Matrix of the New Hospital

Relations between functions

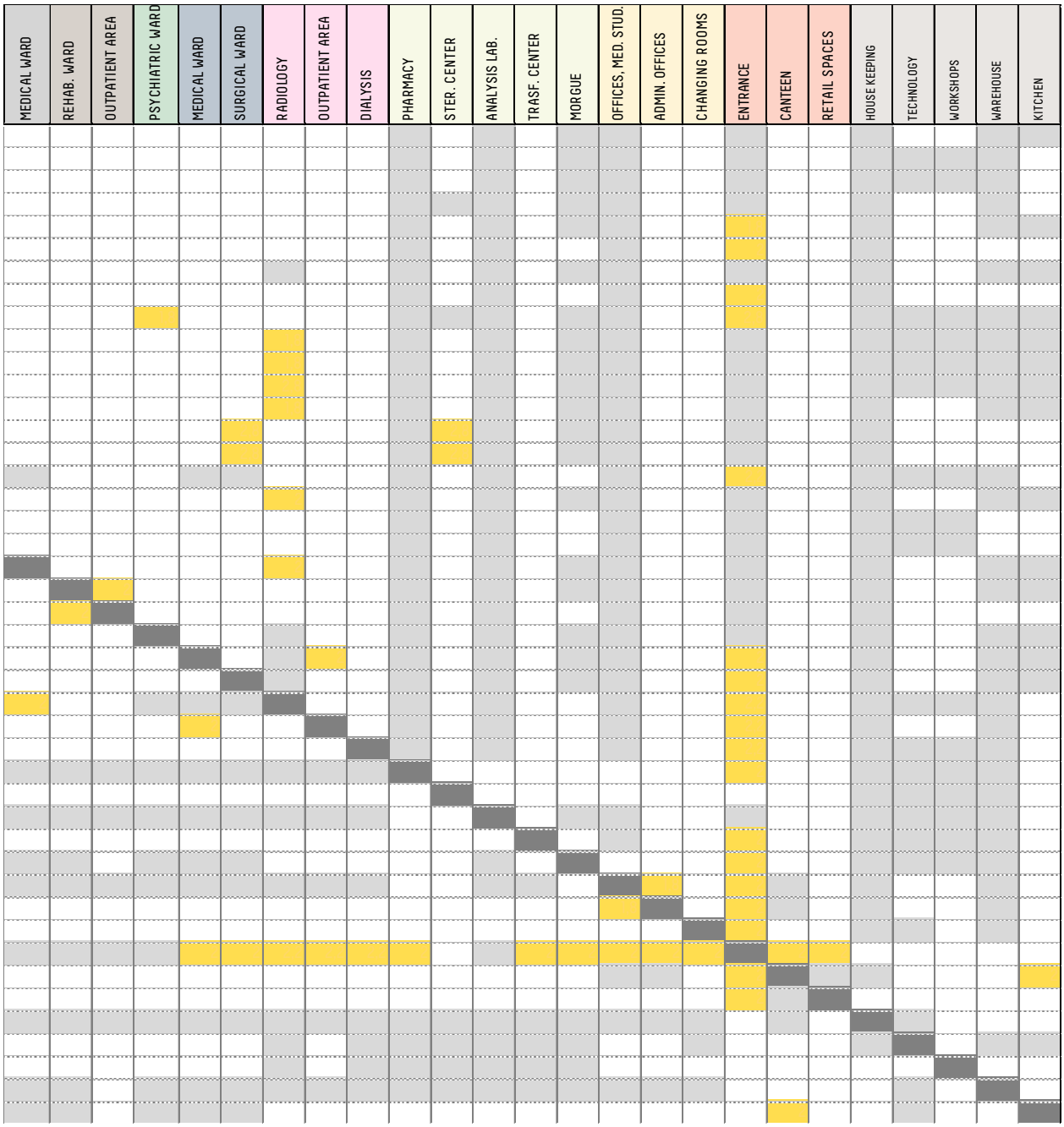
In order to assess the **best scenario of mutual interconnection and spatial location** between the HFOs planned in the New Hospital, the rationality of the pathways and the quality of the healthcare architecture, the relationship matrix tool is used.
By means of the relationship matrix, it is possible to make a qualitative-quantitative assessment of the links between the individual areas of healthcare and support activities



TAB. 3 *Matrix of reports of the New Hospital of Cremona*

in the hospital. Each HFO relationship is classified by assigning specific ratings to criteria, such as **flow type, spatial interference, flow quantity, and related clinical risk**.

Through this assessment, three relational priority classes are identified between the functional areas: **non-derogable interconnection**, **relevant interconnection**, **irrelevant interconnection**.



New Hospital in Cremona

international design competition

TOWARDS A NEW HOSPITAL MODEL

2 | DESIGN GUIDANCE DOCUMENT

Ospedale di Cremona
dal 1451

Sistema Socio Sanitario
Regione Lombardia
ASST Cremona