



Towards personalized and systems medicine in COPD: the CIRO experience

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Outline of presentation

- CIRO
- COPD
- Personalized medicine
- Systems medicine

CIRO+: short history



-1918: sanatorium tbc
-50s: lung center 500 beds
-1985: collaboration with MUMC
-1987: astmacentre, focused on COPD (coal mining)
-2010: CIRO⁺: independent legal entity (MUMC main shareholder)

Mission statement

CIRO+, centre of expertise for chronic organ failure, is a centre that bundles knowledge in the realm of diagnosis and integrated treatment of patients with chronic organ failure



CIRO AND INNOVATION



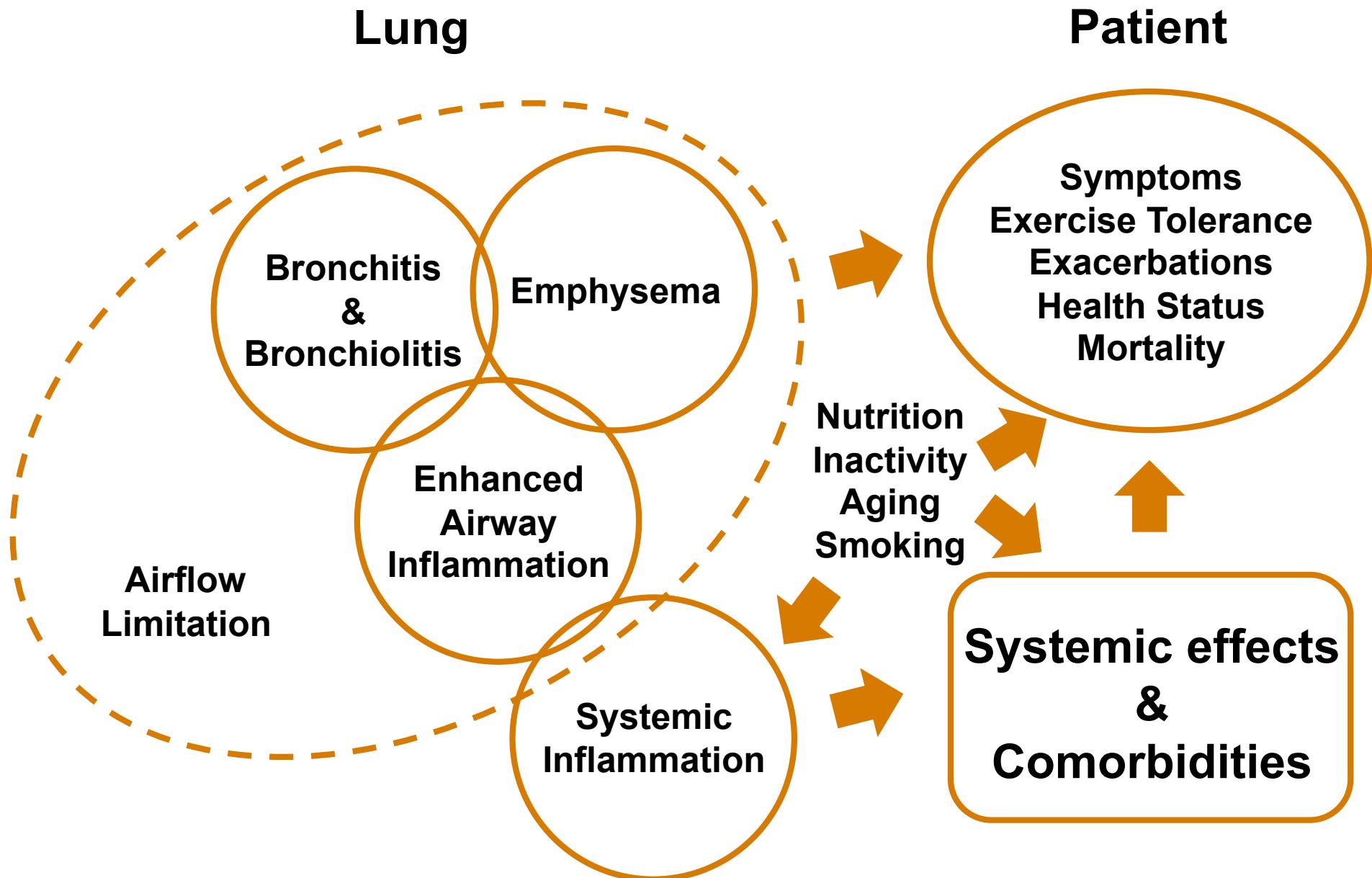
Updated definition of COPD



Chronic obstructive pulmonary disease (COPD), a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases.

Exacerbations and comorbidities contribute to the overall severity in individual patients.

COPD as a heterogenous and multi-component disease



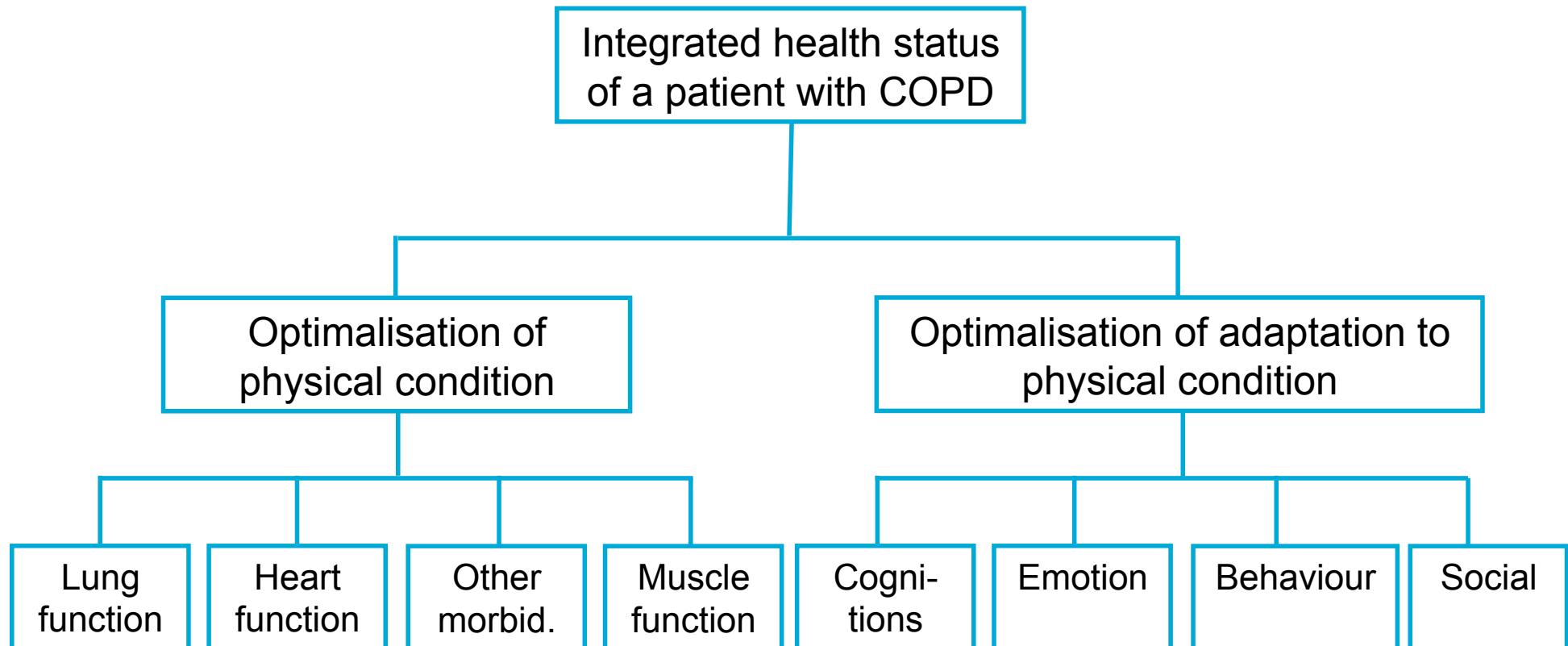
Patient stratification

The Right Treatment
At The Right Dose
For The Right Patient
At The Right Time
For The Right Outcome

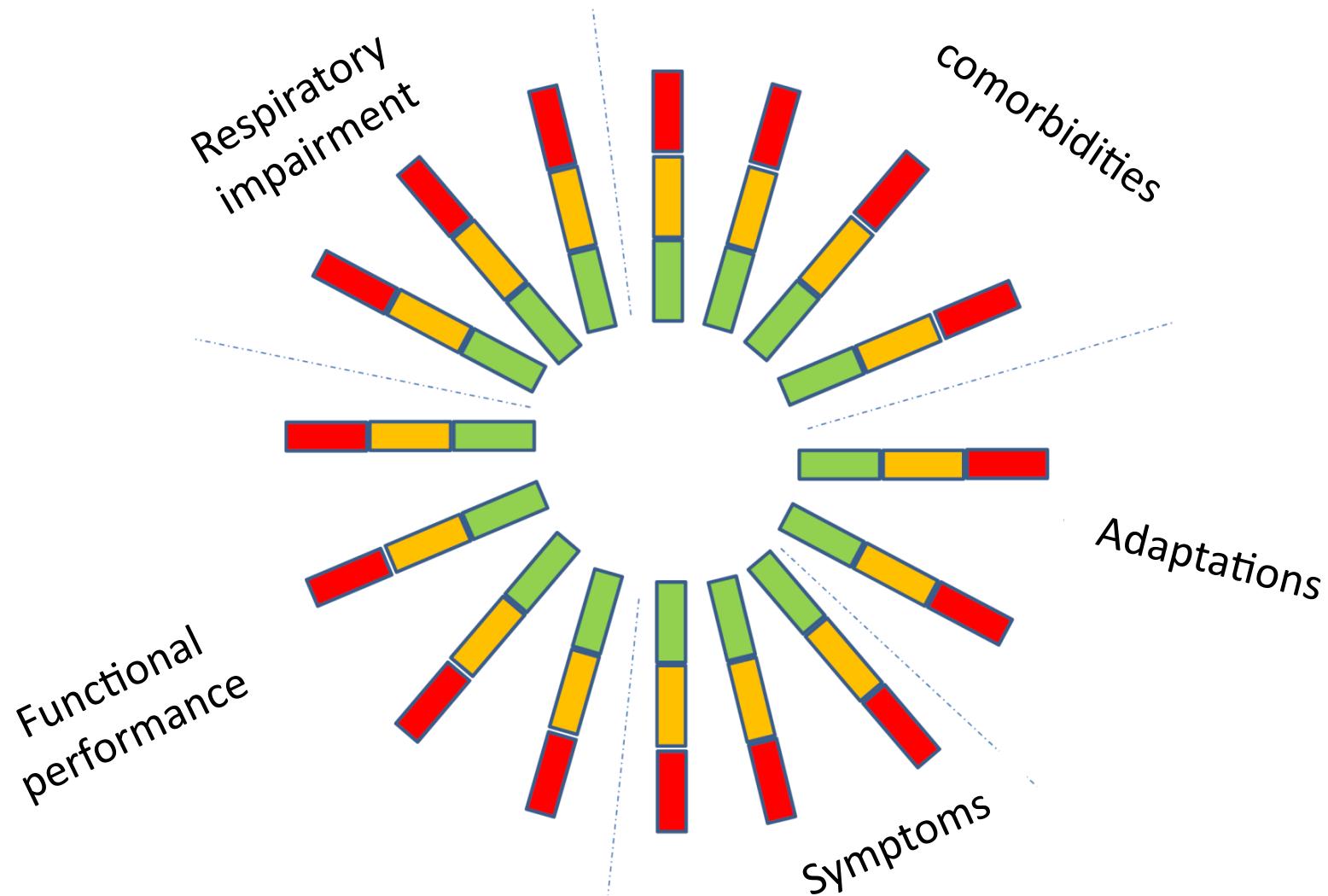
American Thoracic Society / European Respiratory Society definition of pulmonary rehabilitation 2013

‘Pulmonary rehabilitation is a comprehensive intervention based on a **thorough patient assessment** followed by patient-tailored therapies, which include, but are not limited to, exercise training, education and behavior change, designed to improve **the physical and emotional condition of people with** chronic respiratory disease and to promote the long-term adherence of health-enhancing behaviors’

Overview of the three-day assessment in CIRO

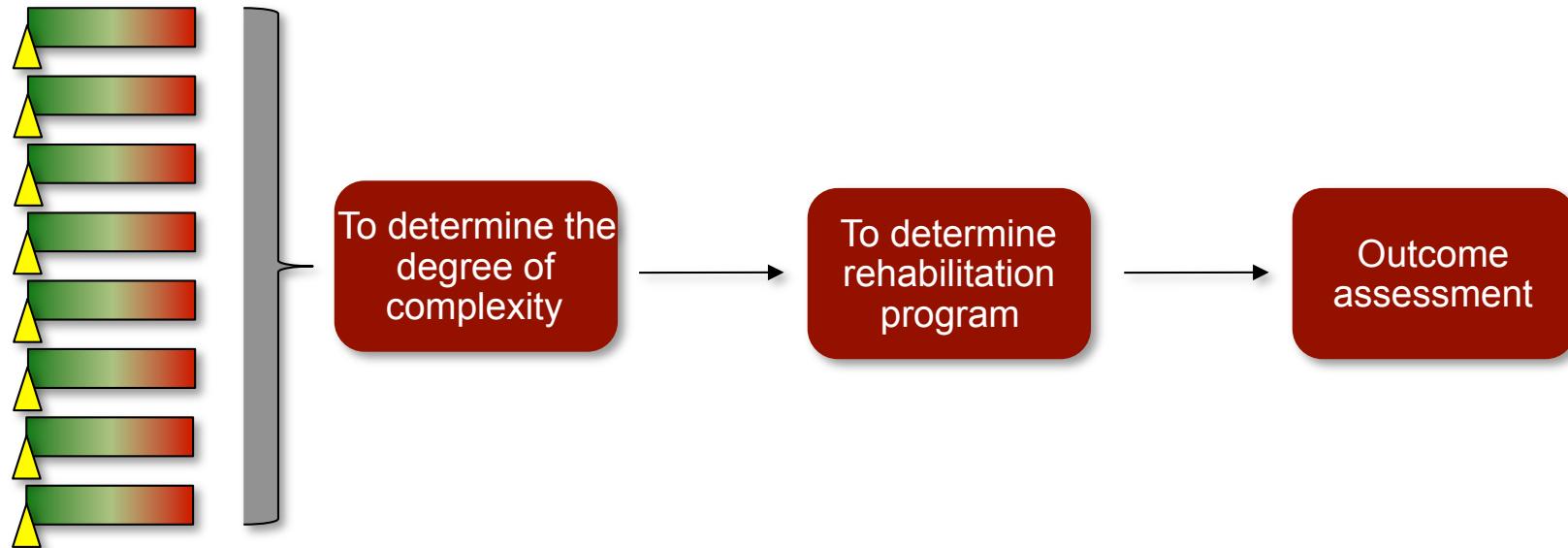


Integrated assessment

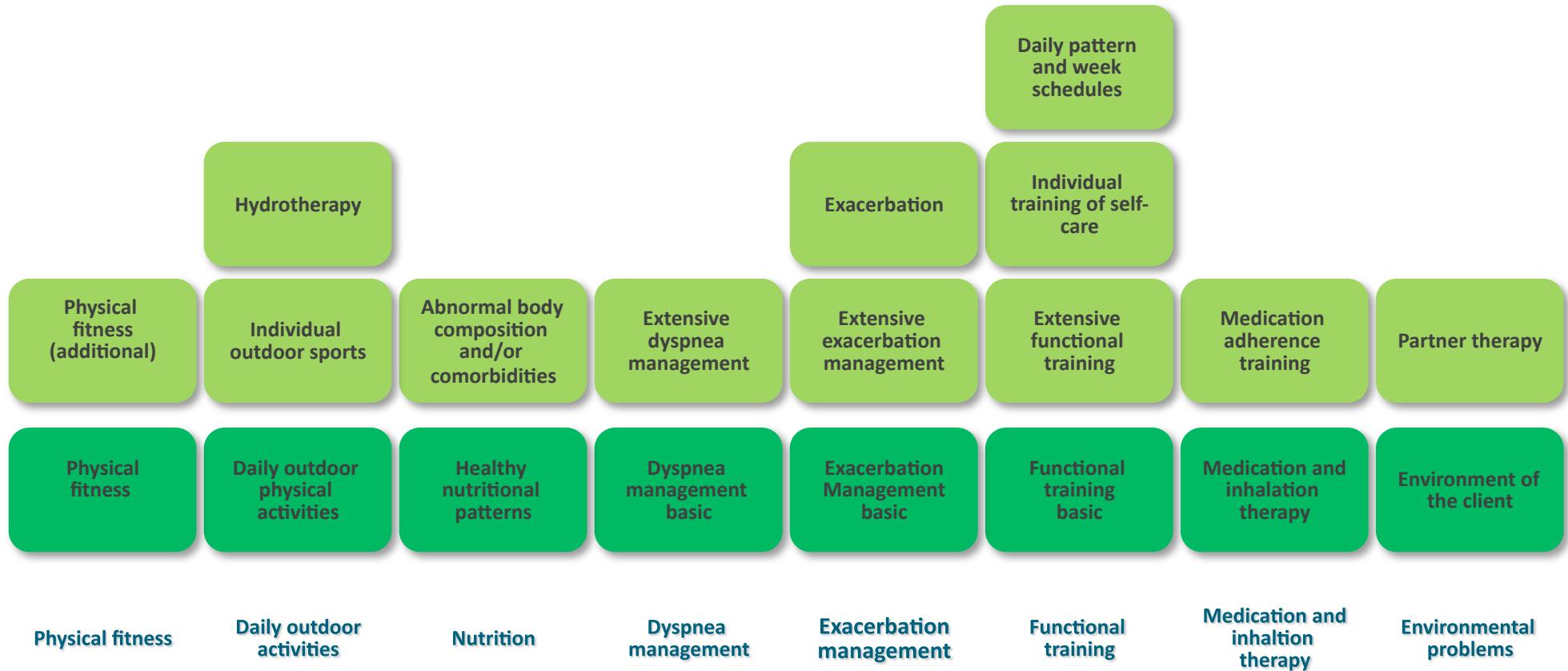


Complexity of intervention

Baseline intake and assessments

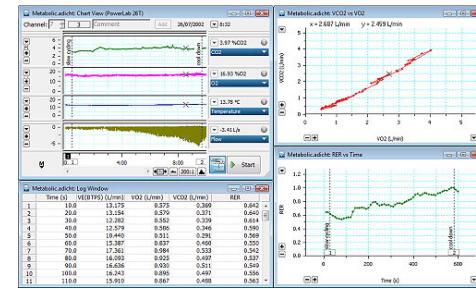
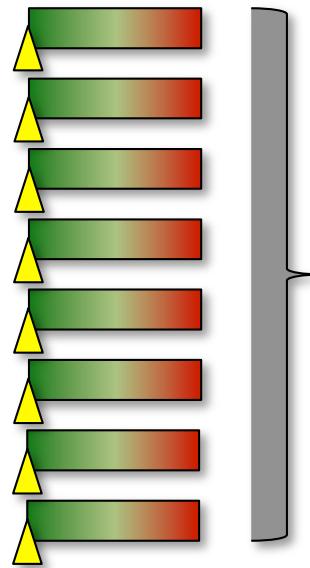


Pulmonary rehabilitation modules



CIRO+ and innovation

Baseline intake and assessments

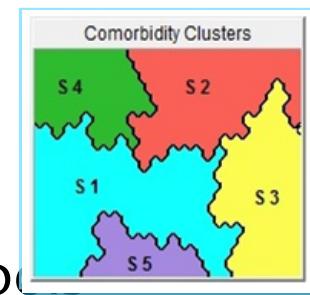


To determine the degree of complexity

To determine rehabilitation program

Outcome assessment

- New, standardized measurements
- New visualization technologies
- New computational/mathematical tools



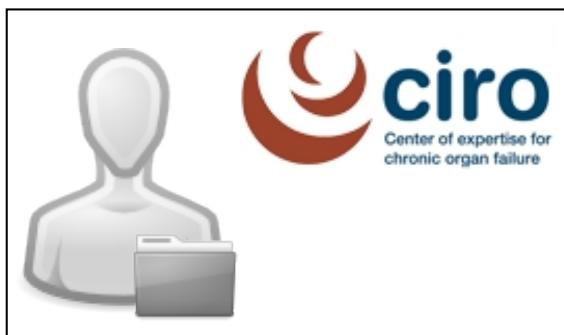
P4 Medicine

● PREDICT ● PREVENT ● PERSONALIZE ● PARTICIPATE

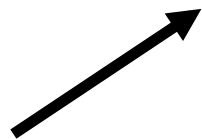
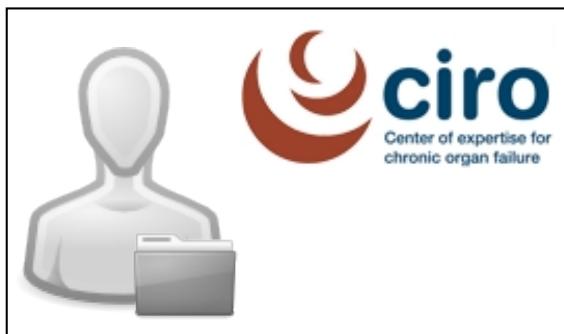
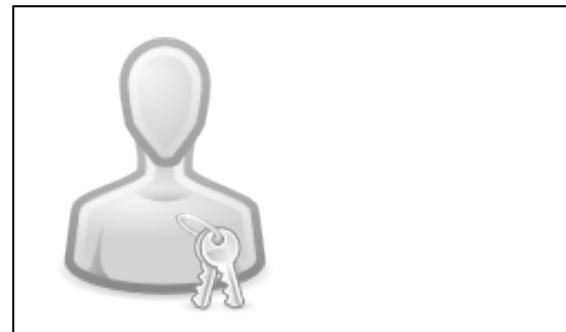


- The right treatment
- At the right dose
- For the right patient
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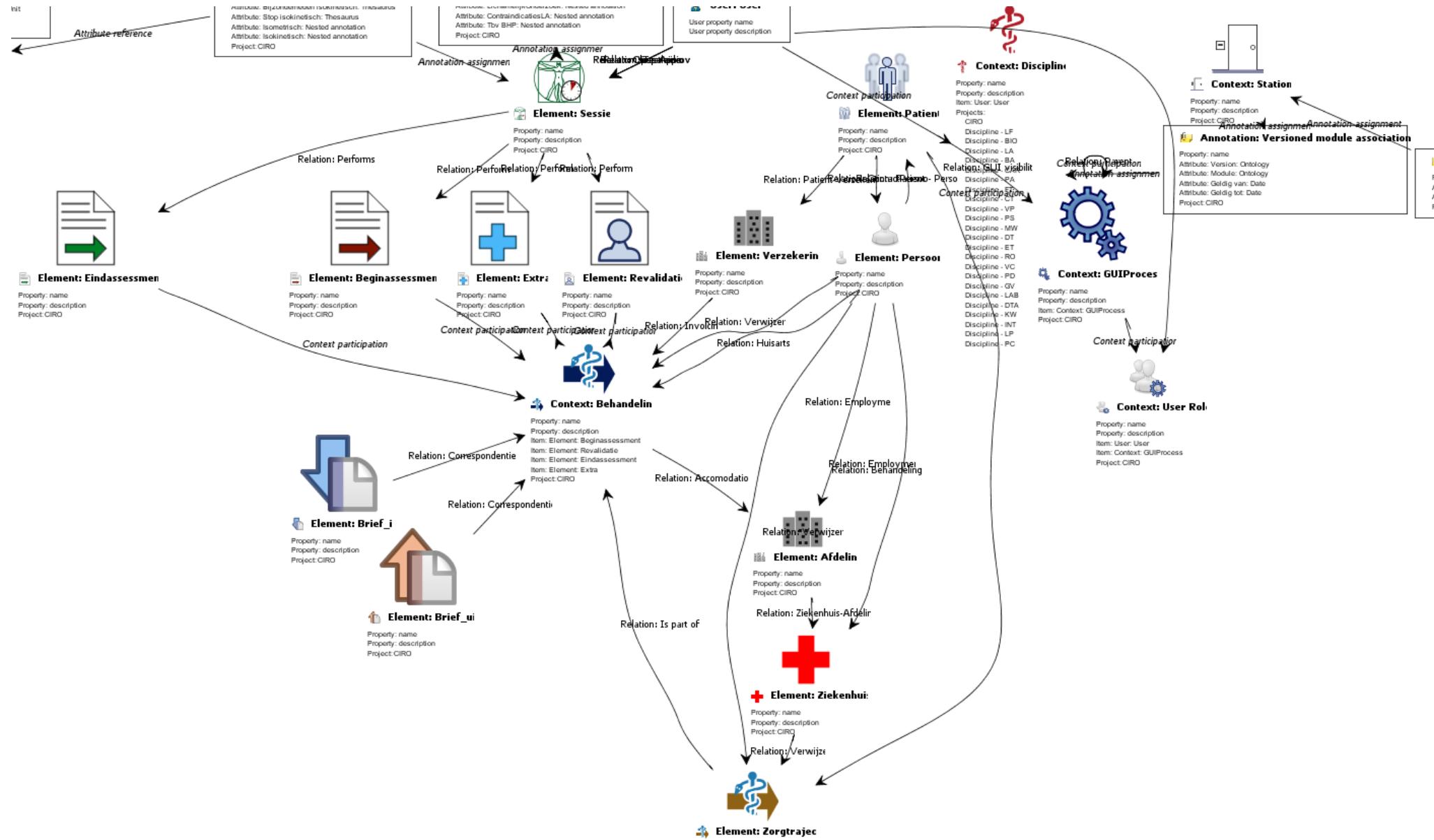
CIRO+ Data Center



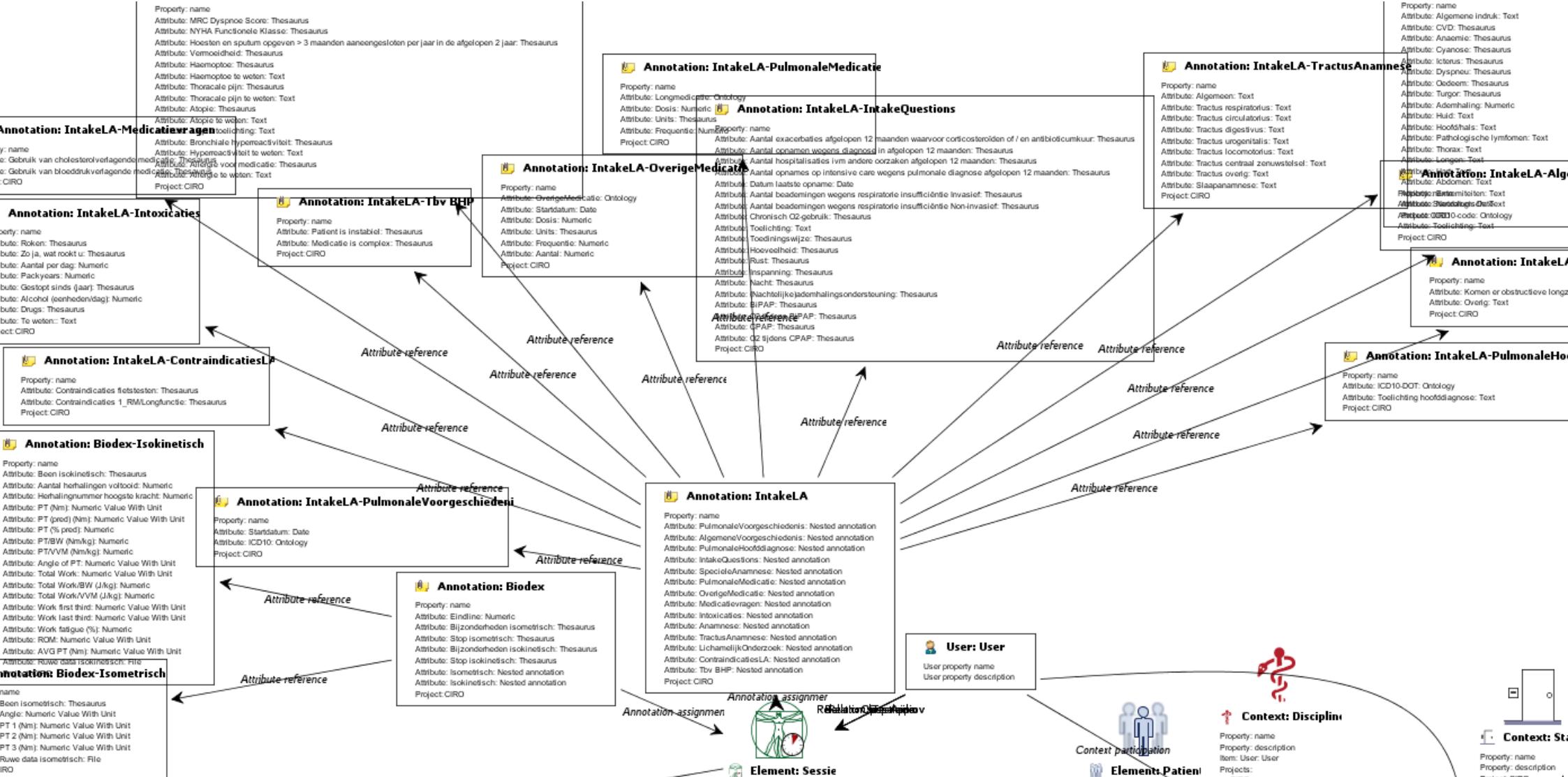
CIRO+ Data Center



Data capturing system

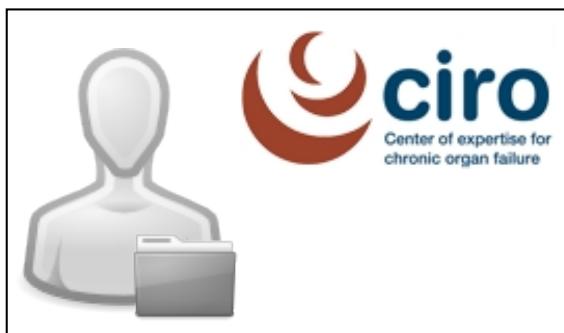
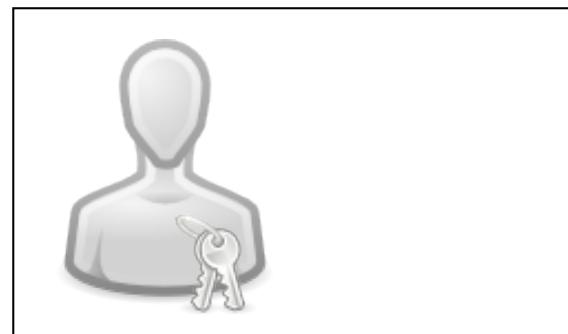
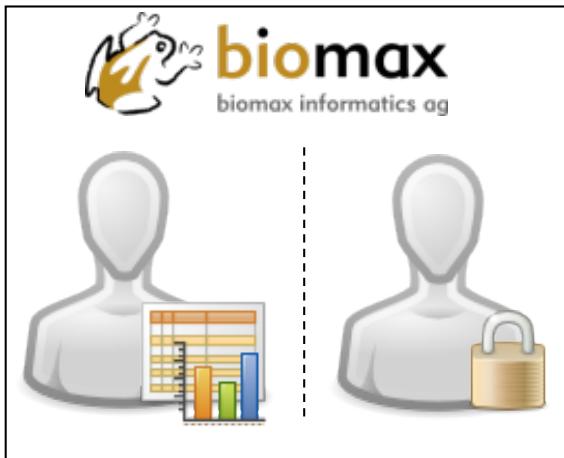


Data capturing system

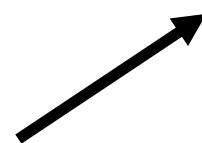
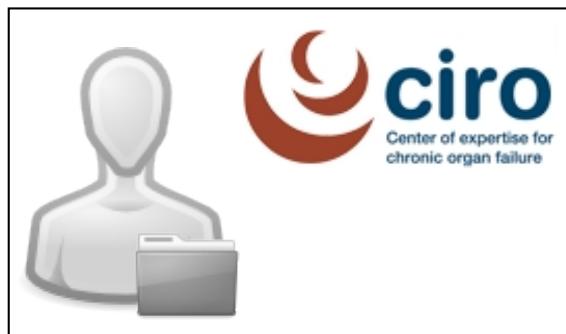
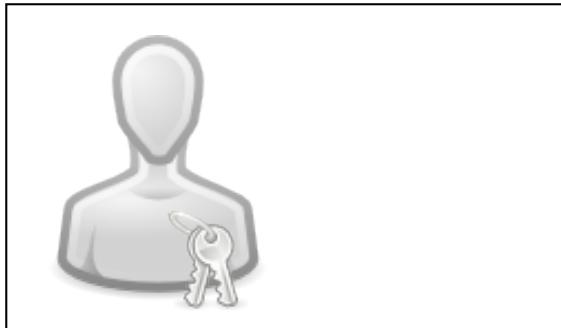
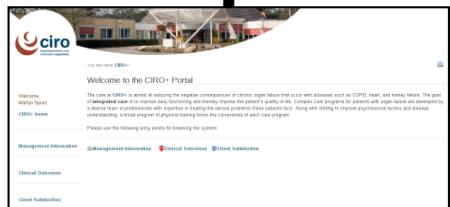
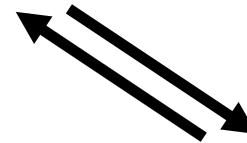
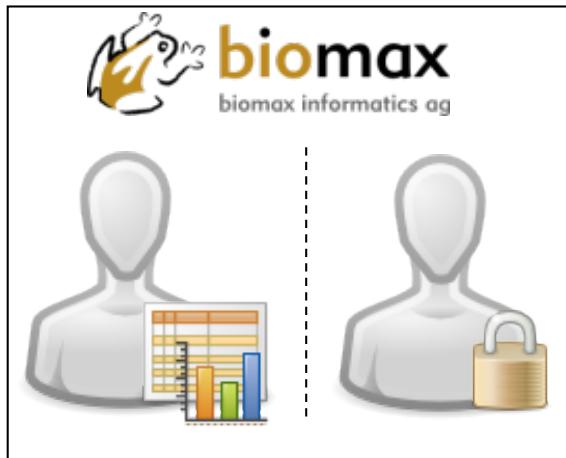




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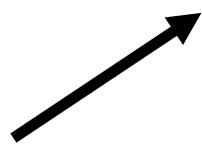
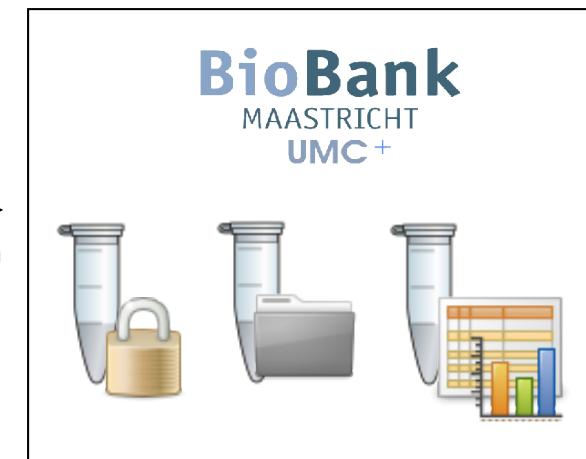
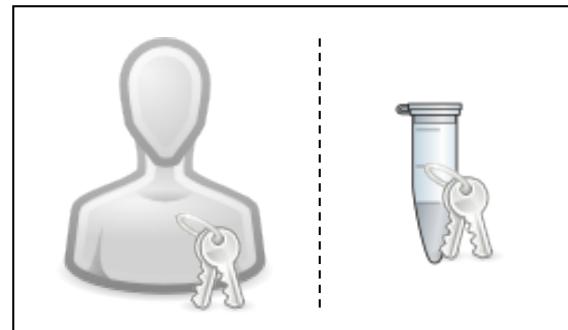
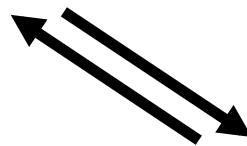
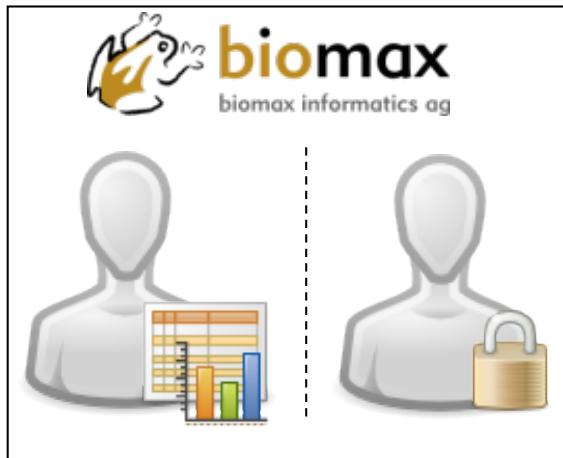


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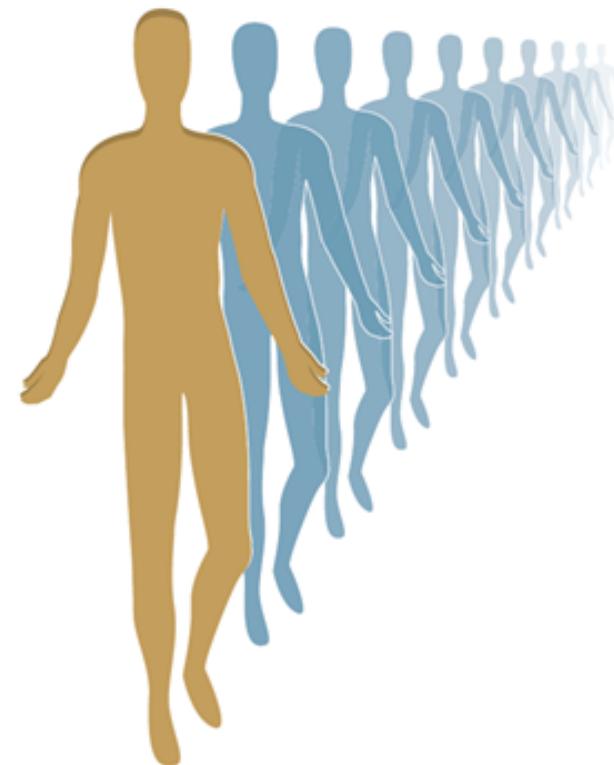


CIRO+ Data Center





- Improve patient care
- Better management of treatment costs



TREAT THE INDIVIDUAL WITH THE KNOWLEDGE OF ALL

P4 medicine: Preventive, Predictive, Personalized, Participatory

A medicine that focuses on the integrated diagnosis, and treatment and prevention of disease in individual patients

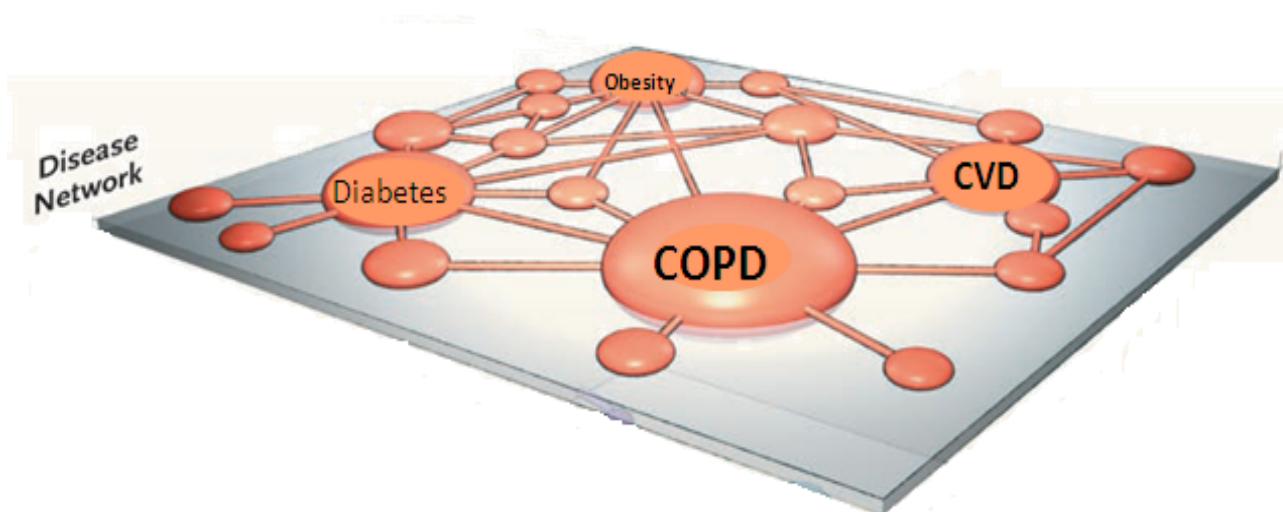
Hood et al, Science 2004
Hwang et al, Mol Syst Biol 2009

Systems medicine: definition

Implementation of systems biology approaches in medical concepts, research and practice, through:

- iterative and reciprocal feedback between data-driven computational and mathematical models
- model-driven translational and clinical investigation and practice.

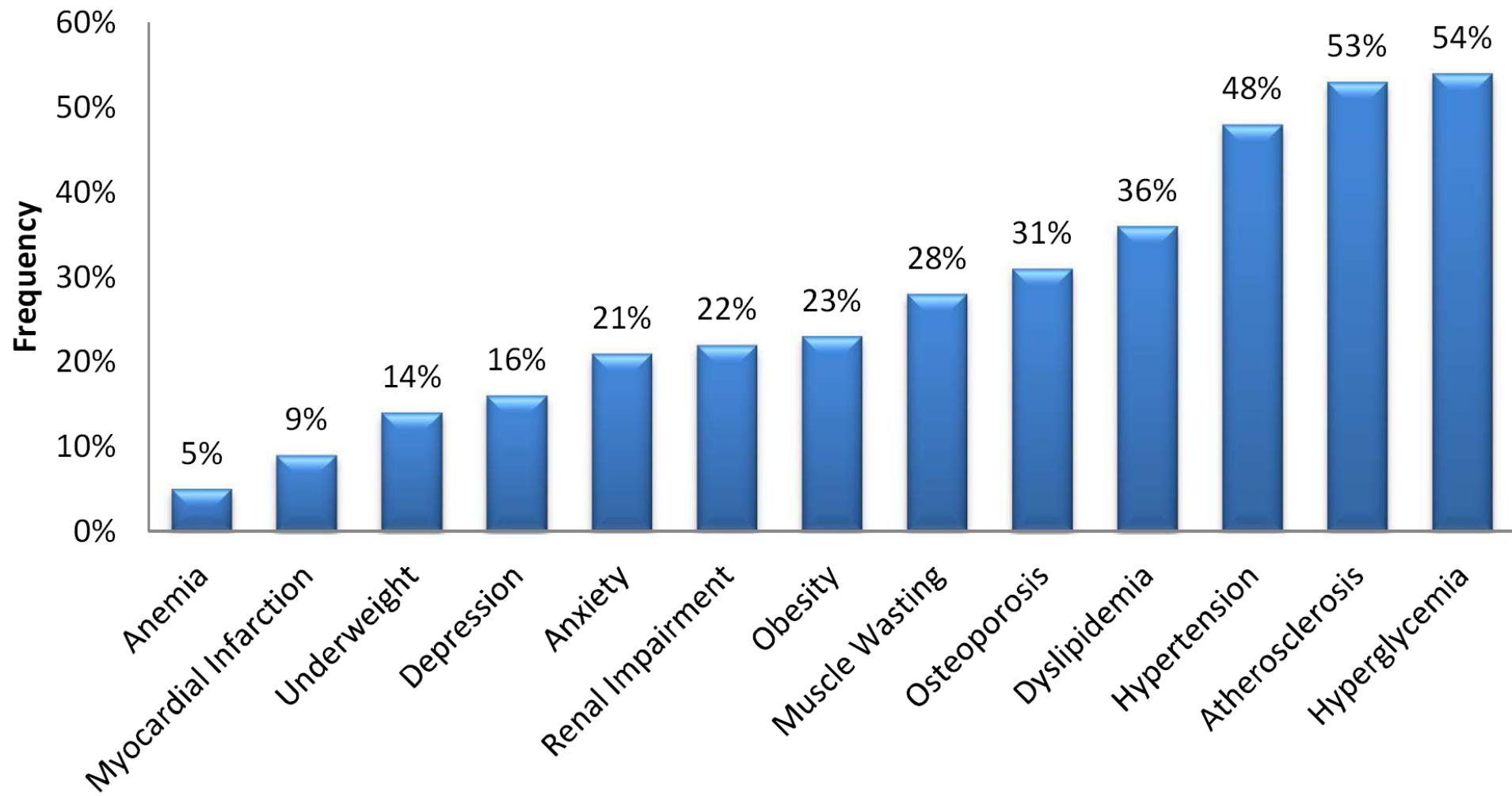
Network medicine



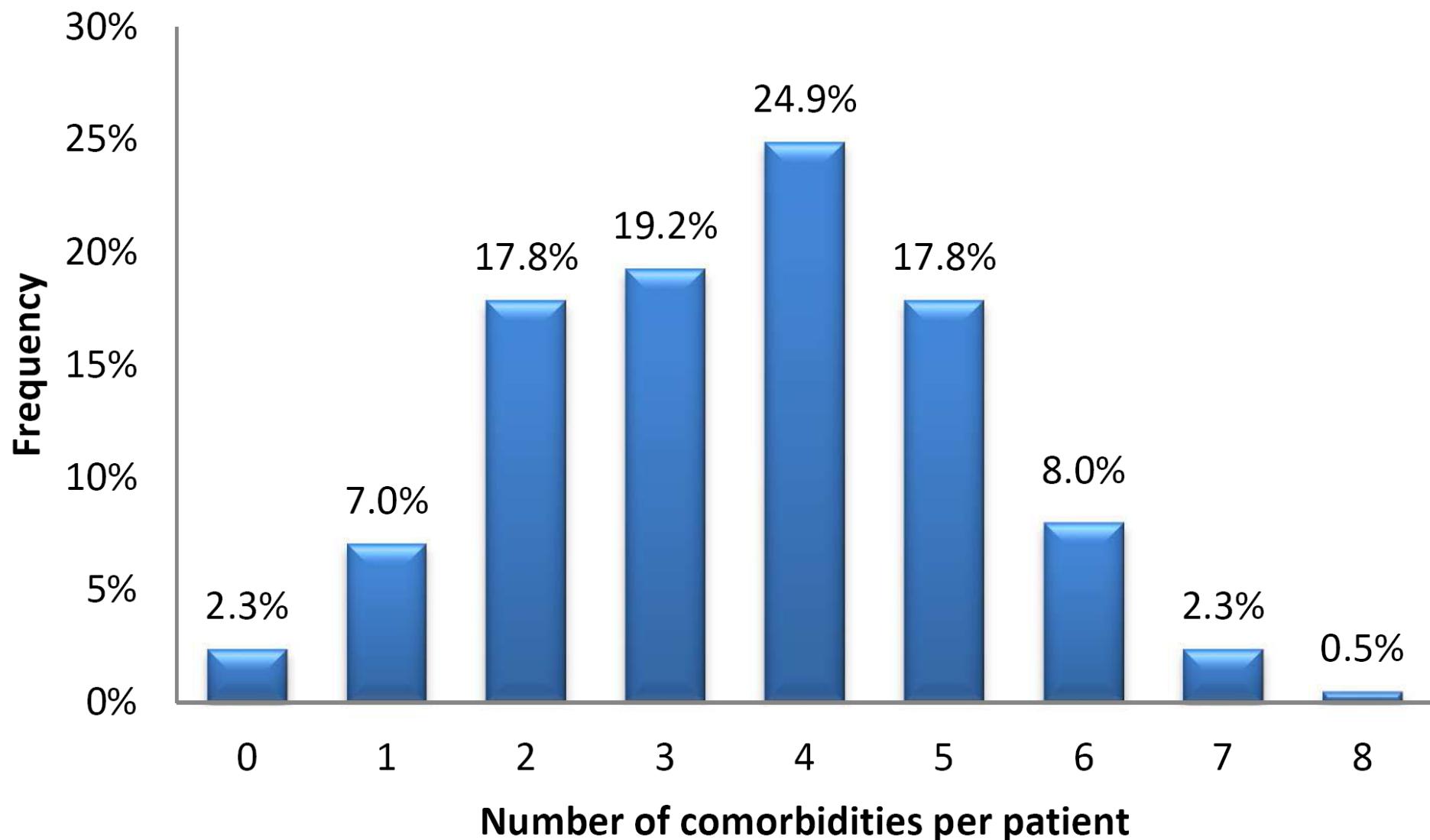
- Chronic disease
- Comorbidities
- Extra-pulmonary features

Adapted from: Barabasi et al, New Engl J Med 2007

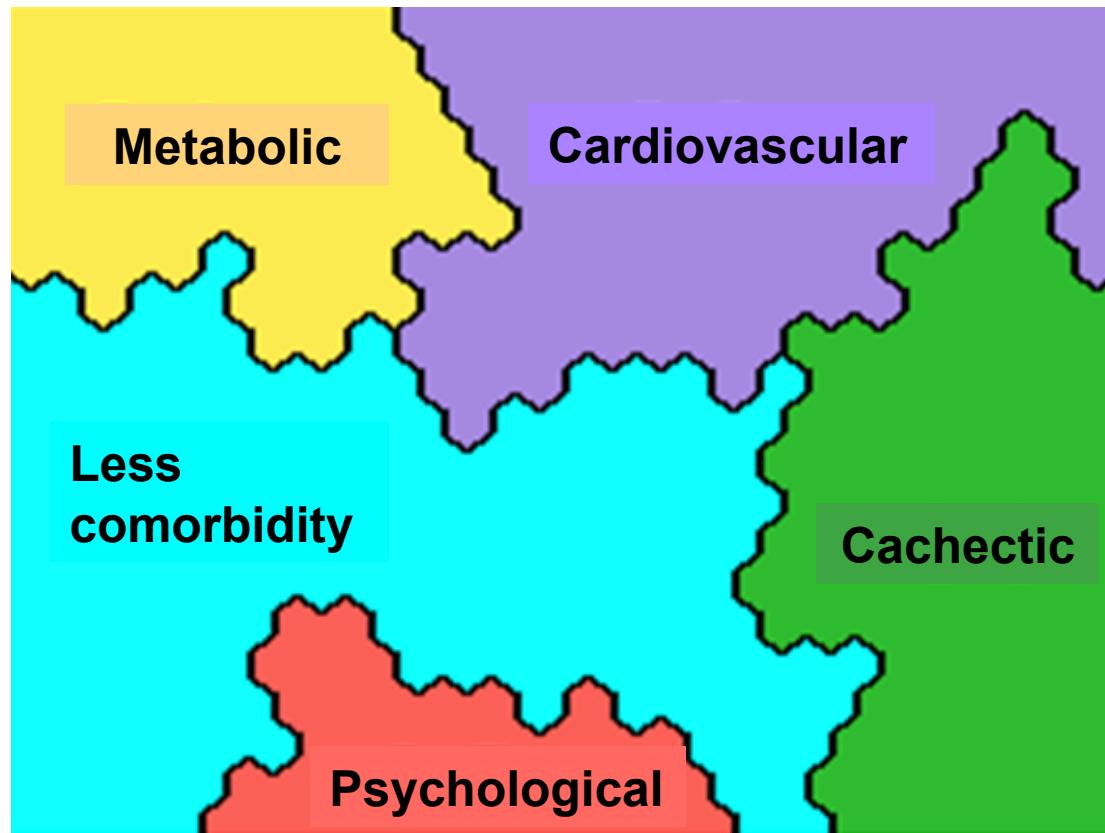
Assessment of objectively identified comorbidities (10)



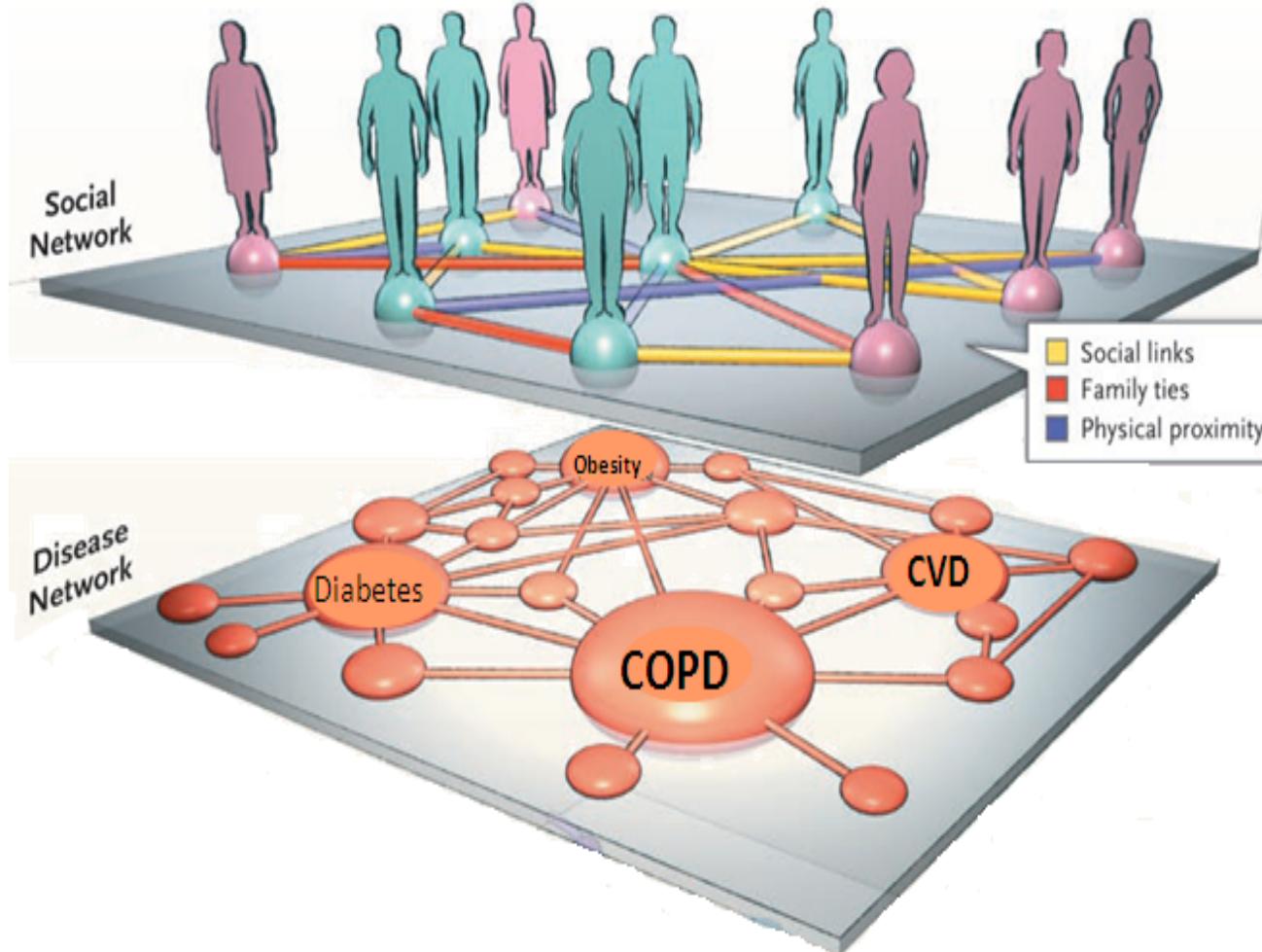
Number of objectively identified comorbidities



Identification of five comorbidity clusters



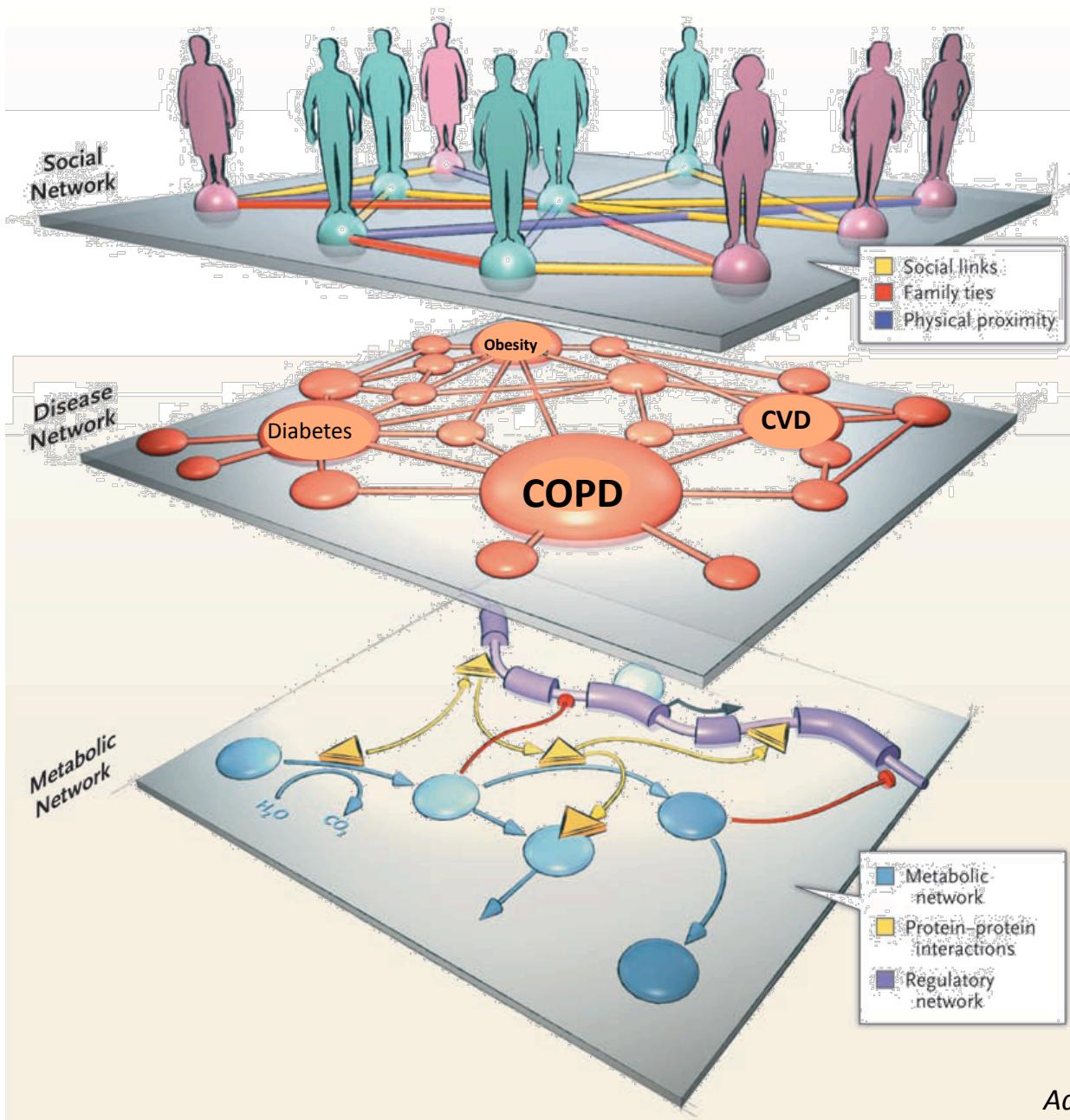
Network medicine



- Psychological aspects
- Healthy life style (activity)
- Autonomy and participation
- Social networks
- exposome: metagenomics
- Intrauterine development

- Chronic disease
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Network medicine



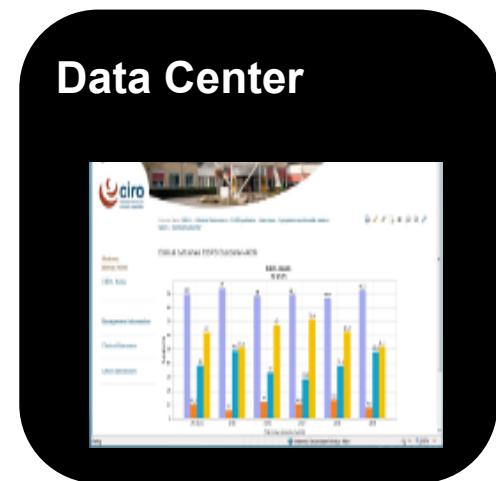
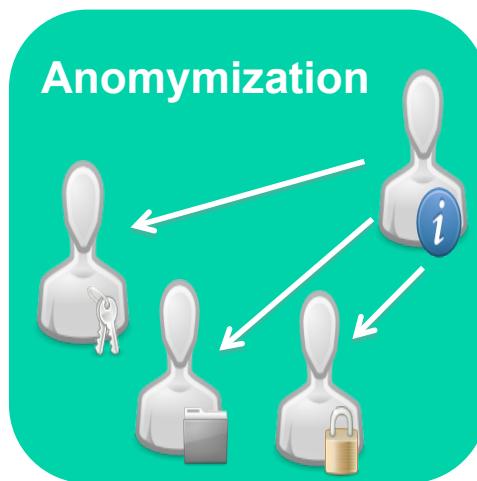
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- Chronic disease
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- Inflammation
- Oxidant/anti-oxidant imbalance
- Ageing
- Metabolic changes
- Immunology
- Genetics

Adapted from: Barabasi et al, New Engl J Med 2007

Ecosystem of the CIRO+ Integrated Knowledge System (IKS)



IKS core



Addressing the complexity of chronic diseases

- To detect disease at an early stage, when it can be controlled effectively.
- To stratify patients into groups, enabling the selection of optimal therapy.
- To reduce adverse drug reactions through the early assessment of individual drug responses.
- To improve the selection of new biochemical targets for drug discovery.
- To reduce the time, cost, and failure rate of clinical trials for new therapies.
- To shift the emphasis in medicine from reaction to prevention and from disease to wellness.

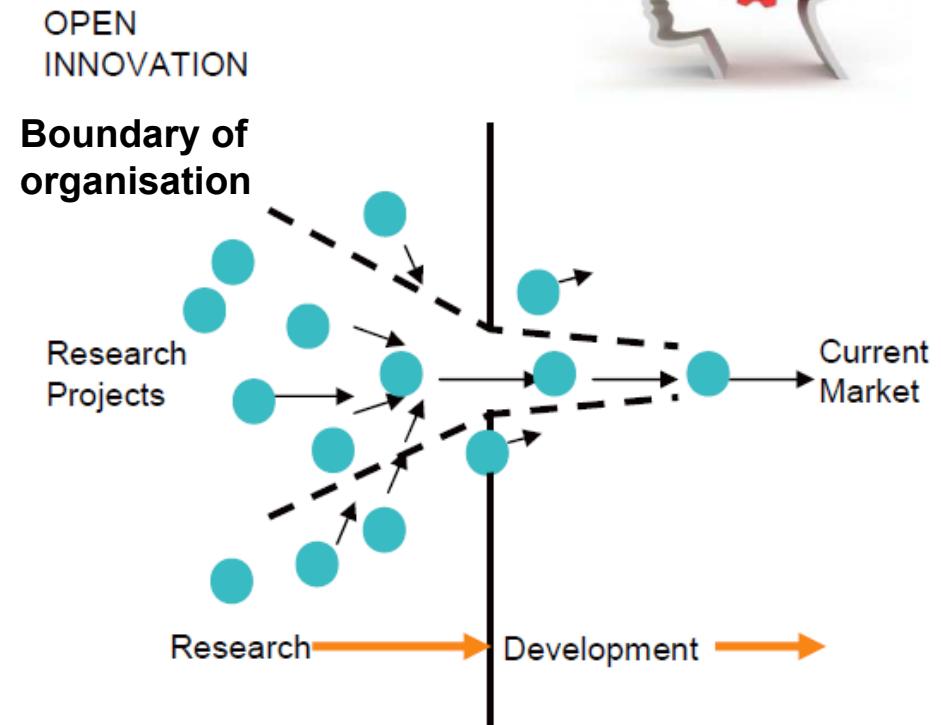
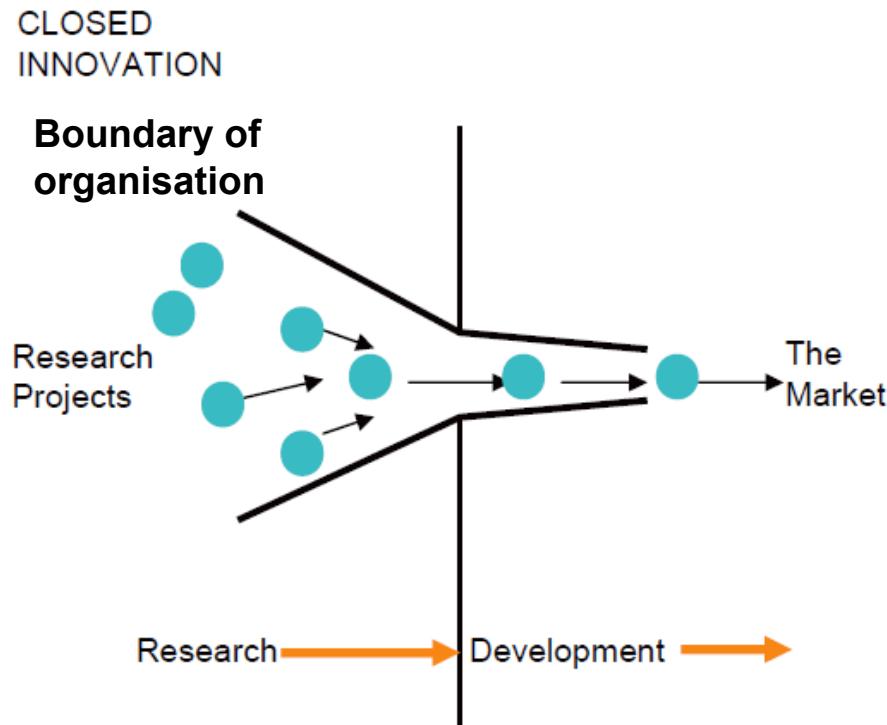
CIRO+: living lab

A “**living lab**” is both a physical location and an organisational framework for open collaboration between different stakeholders with common interests in finding solutions to a given problem or challenge.



Open innovation

Open innovation



Goals of CIRO+ initiative for COPD

- Key for most effective care and to improve patient outcomes



Goals of CIRO+ initiative for COPD

- Key for most effective care and to improve patient outcomes
- Key to empower the patient and the physician in clinical decision making



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- Better disease classification, supported by qualification and standardization of phenotypic measures



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- Key for most effective care and to improve patient outcomes
- Key to empower the patient and the physician in clinical decision making
- Better disease classification, supported by qualification and standardization of phenotypic measures
- To accelerate the achievements of P4 medicine in COPD

