

# Health systems as complex adaptive systems

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# What is a system

A system can be defined by the coming together of parts, interconnections, and purpose

The parts of a system are interesting on their own, but what matters is how they come together and are interconnected.

## Thermostat

Consists of various independent parts, which are interconnected to achieve a specific purpose (maintaining a desired temperature).



## Health system

Consists of various independent parts (clinics, pharmacies, laboratories), which are interconnected (through patient flows and information) to achieve a specific purpose (maintaining and improving health).



# What is the difference between a health system and a thermostat?



It is possible to predict what each part will do in response to a given stimulus.

One can study the system in great detail and predict how it will behave under different circumstances.

**A** → **B**



The "parts" (people) have the freedom and the ability to respond to stimuli in unpredictable ways.

Such behaviour can be for better or for worse, leading to innovation or to error.

It is impossible to predict the behaviour of the system.

**A** → **B**



# What happens when you treat a health system like a thermostat?

“System designers” often “construct” complex human systems as if the behaviour of the parts and interconnections were predictable, when in fact they are not.

«When the human parts do not act as expected or hoped for, we say that people are being “unreasonable” or “resistant to change,” their behavior is “wrong” or “inappropriate.” The system designer’s reaction typically is to specify behavior in even more detail via laws, regulations, structures, rules, guidelines, and so on. The unstated goal seems to be to make the human parts act more mechanical.»

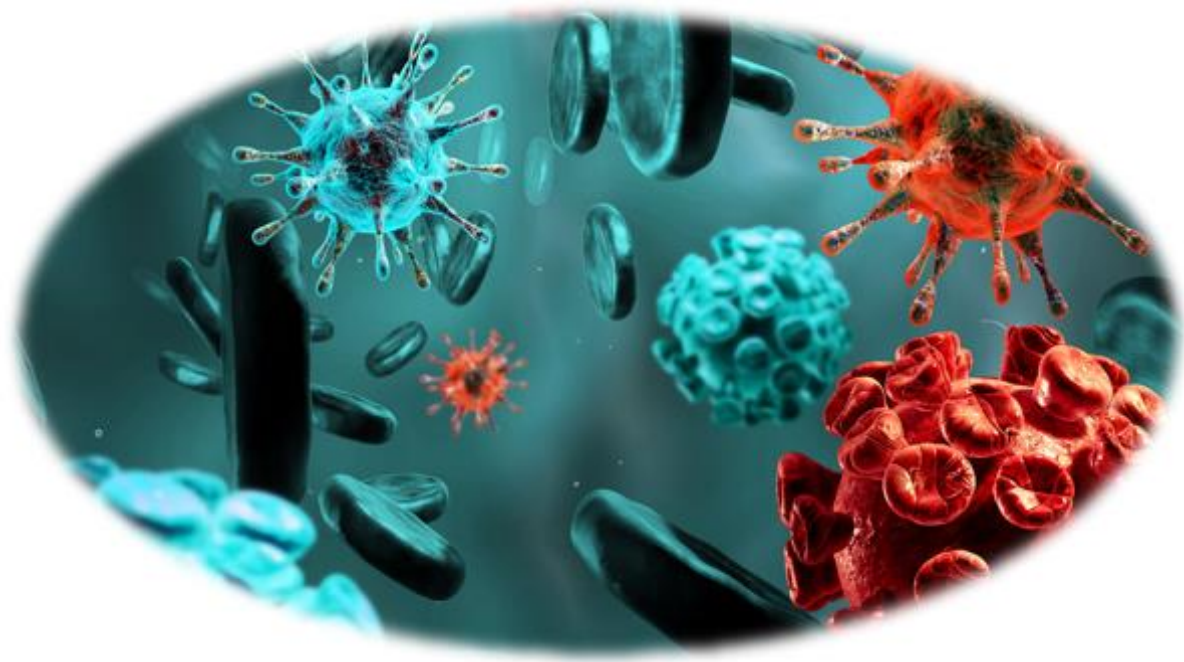
*Paul Plsek «Redesigning Health Care with Insights from the Science of Complex Adaptive Systems». 2001.*



# Complex adaptive system

A complex adaptive system (CAS) is a set of agents, each acting freely and not always predictably. They are interconnected: the actions of one change the context for others.

Example:  
The human immune system



# Properties of a complex adaptive system

## **Adaptable Elements**

Elements of the system can change on their own

Antibiotic-resistant bacteria; a person in the process of learning

## **Simple Rules**

A few simple rules, applied locally, can lead to complex outcomes

Traffic rules; a starling flock (each bird follows three rules – stay together, avoid collision, mimic neighbors)

## **Nonlinearity (the butterfly effect)**

Small changes can have large effects

An avalanche (snow rests quietly for decades but one step of a skier leads to a massive collapse); a large-scale corporate program may yield no result, while a random rumor can trigger real change

## **Emerged behaviour, novelty**

Constant creativity is the natural state of the system

Ideas emerging in the mind; behaviour of the stock market



# Properties of a complex adaptive system

## **Unpredictability, especially in detail**

Since elements are changeable, relationships are nonlinear, and behaviour is unexpected, the only way to find out what a CAS will do is to observe it

Weather forecasting

## **Inherent Order**

Systems can be ordered even without centralized control. Self-organization

An anthill; the stock market; the internet

## **Context and embeddedness**

Systems exist within systems

Organs within a body; streams and tributaries forming a river basin

## **Coevolution**

Tension and equilibrium

Host-parasite coevolution; competition between companies



# Paradoxes of a complex adaptive system

- We cannot know in advance what the system will do or how to optimize it
- Relatively simple rules can lead to complex, innovative system behaviour
- Managing a complex adaptive system does not have to be complicated. **The solution is to create conditions for self-organization through simple rules that allow for adaptation**



# Health systems are complex adaptive systems

## Elements of the system can change on their own

Opening an endoscopy unit reduced waiting lists and eased the workload of the surgical inpatient department.

## Simple rules can lead to complex outcomes

The rule "wash hands before entering a patient's room" stopped an outbreak in the ward.

## Small changes can have large effects

A cleaner moved the water cooler into the hallway and doctors became less tired and made fewer errors.

## Constant creativity and novelty

A nurse suggested colored wristbands for patients with allergies and, within a year, they were used across the entire region.



# Health systems are complex adaptive systems

## Unpredictability, especially in detail

They calculated the number of beds but the ambulance brought thirty people with food poisoning in one hour.

## Can be ordered even without centralized control

During resuscitation, everyone knows what to do without any commands.

## Systems exist within systems

An emergency department is part of the hospital, the hospital is part of the district network, the district network is part of the national system.

## Coevolution

Patients got used to receiving test results via chat and the laboratory had to officially adopt this channel.

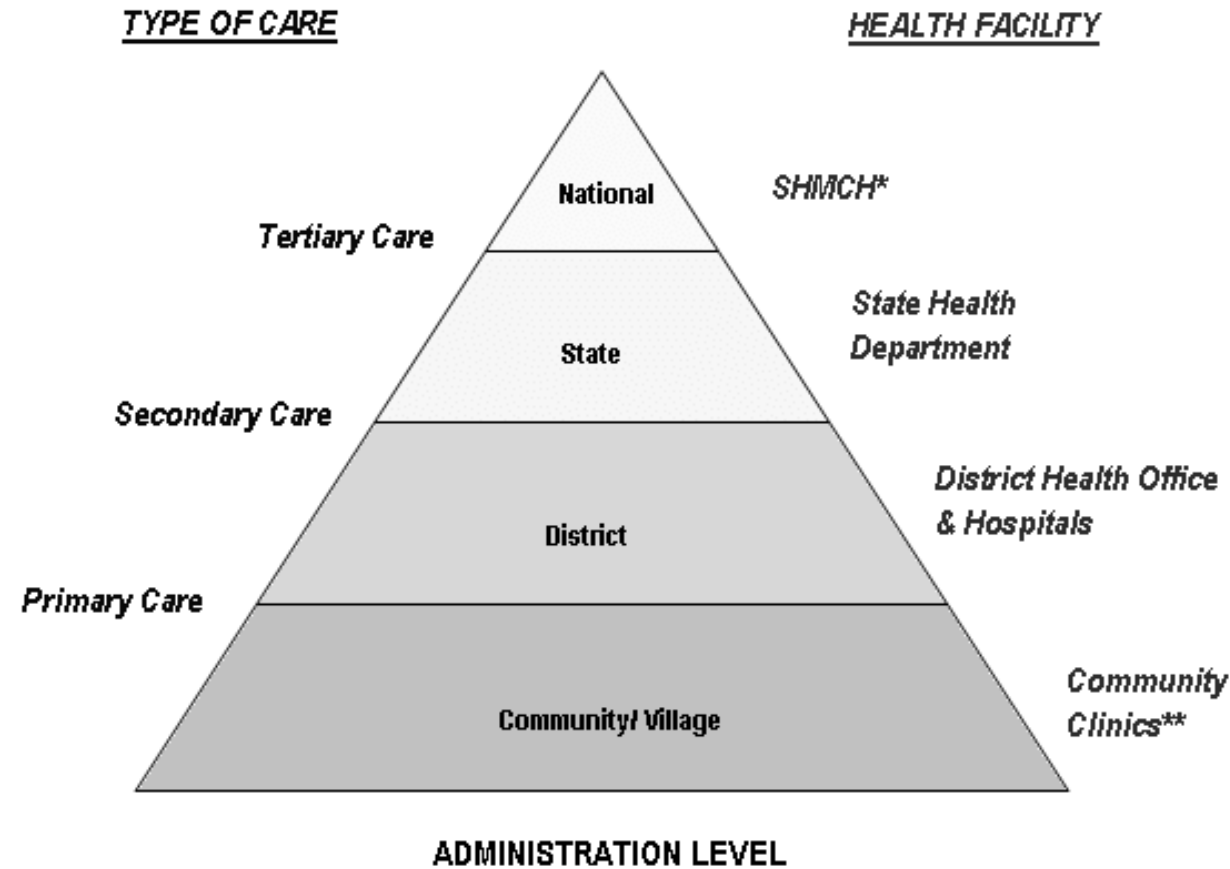


# **How to manage a health system in the context of a complex adaptive system?**

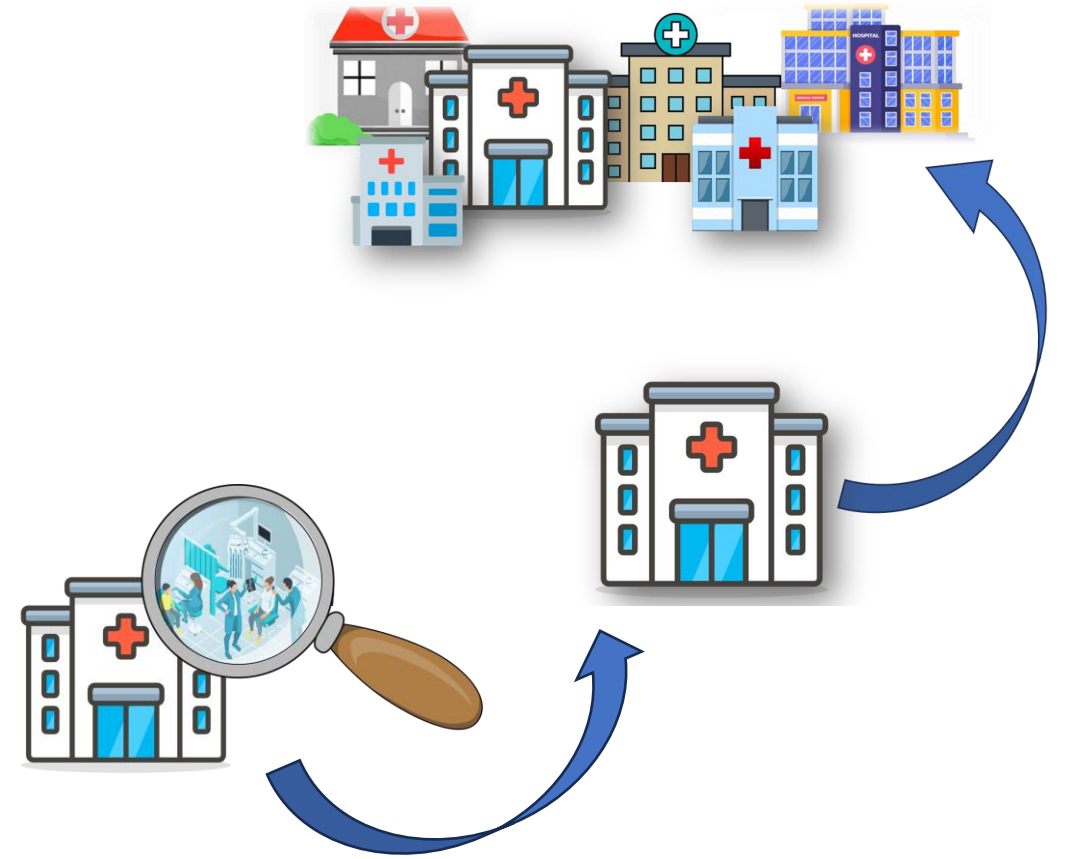
- To create conditions for self-organization  
through simple rules that allow for adaptation**



# Hierarchy in healthcare: what is more important?



# Hierarchy in healthcare: what is more important?



The question is not about the level of hierarchy but about the level of detail



# Levels of detail



**National  
healthcare system**

– it is a health system



**Hospital**

– it is a health system

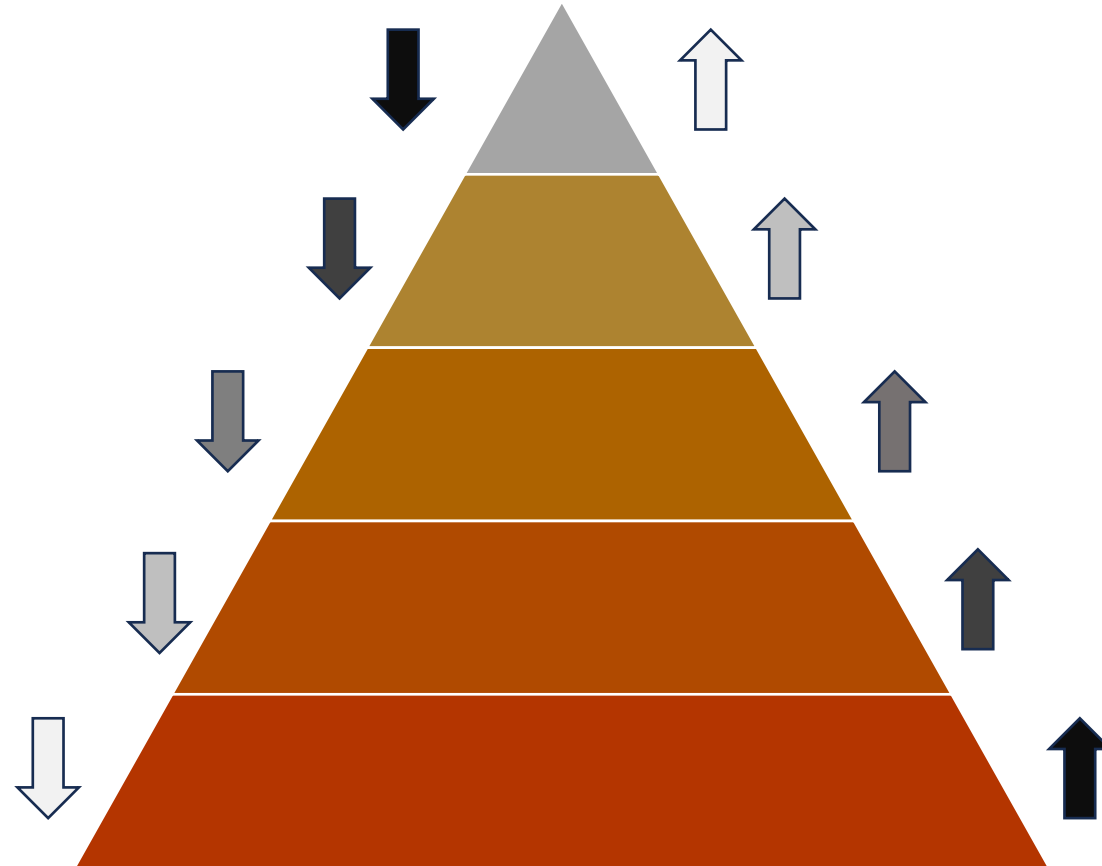


**Department**

– it is a health system

# Rigid hierarchy

Instructions flow from the top down and are modified at each level

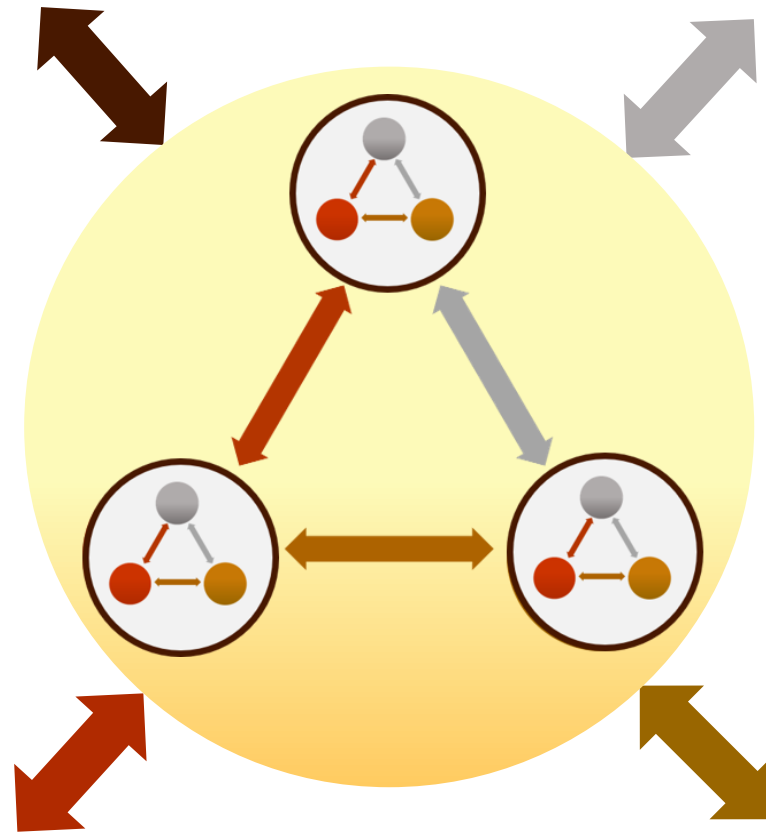


Feedback passes through all levels and does not always reach leadership



# Network interactions and different levels of detail

Instructions are given according to the function of each level

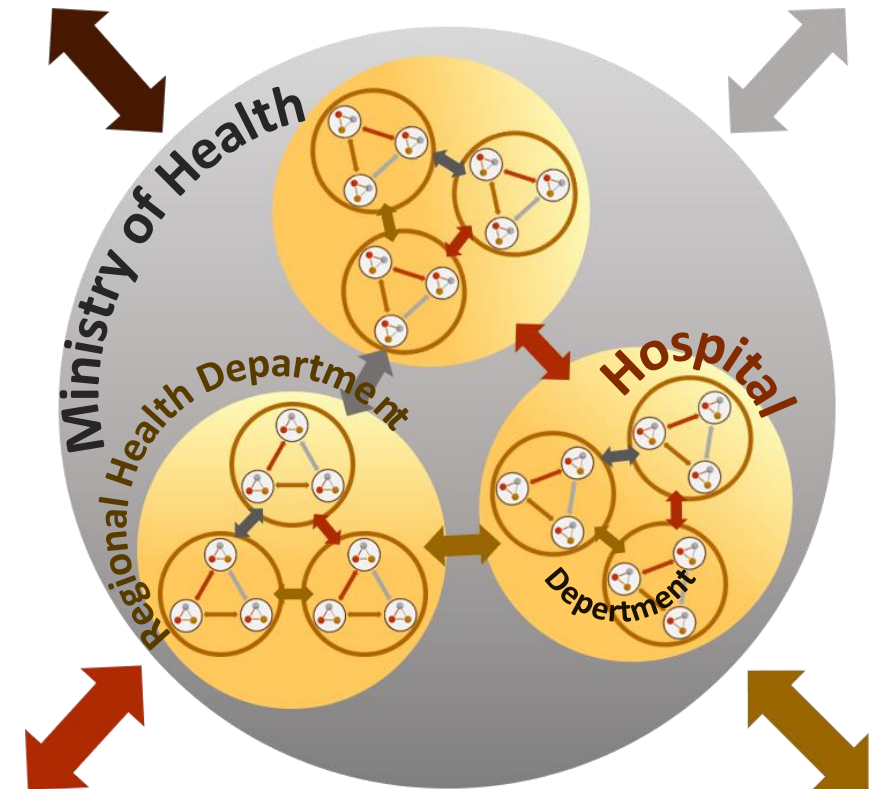
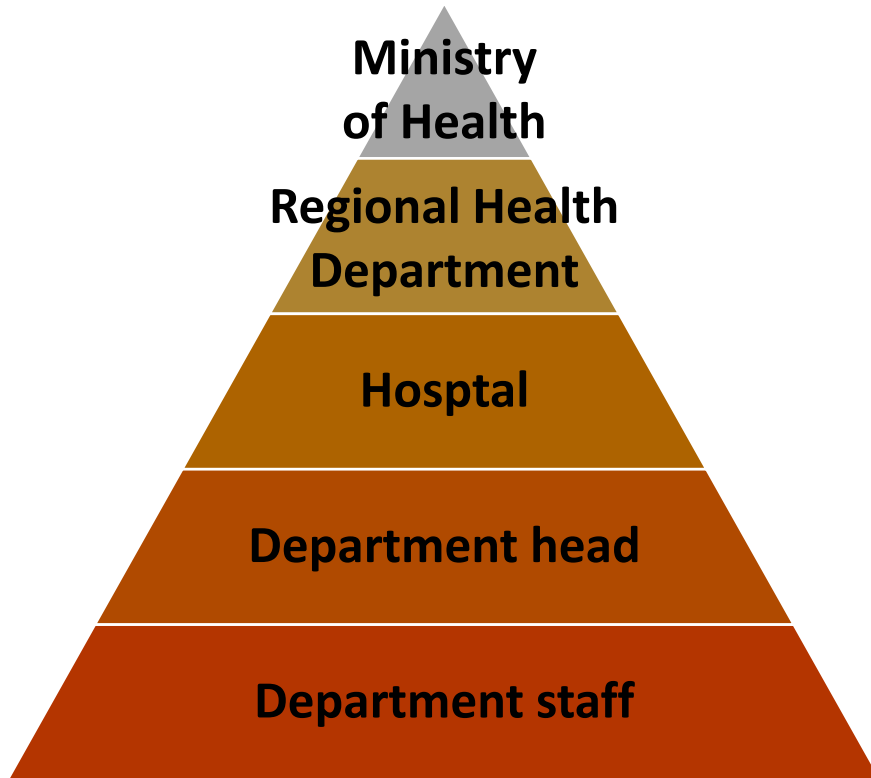


Feedback is given to those who can actually change the situation. Leaders are facilitators rather than commanders

Decision-making authority belongs to the level where the information resides



# From rigid hierarchy to network interactions



We "turn the pyramid sideways": the rigid vertical becomes a network  
All decisions remain within the responsibility of their own level  
Communication becomes more flexible and faster



# From rigid hierarchy to network interactions

## Advantages of the approach

- Authority is distributed more evenly across levels
- Most management happens within each level
- Decisions are made where the information resides
- Feedback loops are closed at the same level where decisions are made
- The path between instruction and execution is shortened
- The path between leadership and the patient is shortened
- A change in leadership does not collapse the entire system



# What else is needed for a system to function at its best?

- Creating conditions for achieving results rather than demanding results
- Managing through simple rules, not rigid orders
- Encouraging diversity: of opinions, knowledge, work models
- Recognizing achievements rather than hunting for weaknesses
- Monitoring system indicators (delayed morbidity, staff burnout, patient trust) rather than KPIs
- Adaptive leadership: everyone is a director in their own role



# Conclusion

- A health system at any level (department, hospital, regional, national) is a complex adaptive system.
- Its behaviour cannot be predicted in detail. But we can create the conditions for it to manage itself.
- A few simple rules are enough. The rest, the system will build on its own.
- Circumstances change and the system learns from its mistakes and adapts.
- Complex order emerges on its own, without central planning.
- A network structure simplifies management. Communication between levels is just as important as communication within a level.

And one more thing:

**“There are no permanent solutions in a dynamic system”**

*Naval Ravikant*



# References

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