Systemic Vision in Medicine

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Abstract: *Linear thought should give way to the systemic view, from the perspective of Complexity Theory. According to this approach in Medicine disease is considered as part of a larger, interconnected whole. From the "Biomedical" model it is necessary to move to the "Biopsychosocial" model. Today it is time to see the human person within and as an integral part of the ecosystem: this is the concept of "One Health". Several new paradigms of care and research arise from this kind of vision: the most important to date is the PNEI Paradigm. But other paradigms are especially engaged on the economic and environmental sustainability front. Without detracting from the significant role of technology, increasingly today's Medicine must reevaluate the fundamental role of the "Medical Humanities", from bioethics to philosophy, from communication to the integration of knowledge and research.*

Key words: *Complexity, Biopsychosocial model, Ecological model, One Health, PNEI Paradigm, Systemic Vision*

Ayurveda, as a science of life, looks at the man in his totality, not as a set of parts, and states that the maintenance of his health cannot be independent from his social and spiritual context, nor separated from his cosmic connection
(Terzani, 2011).

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Introduction

Thomas Kuhn (1922-1996) introduced the concept of the "phases" of science: Preparatory period, Acceptance of the paradigm, Normal science, Birth of anomalies, Crisis of the paradigm, Revolution of the paradigm, New paradigm, Acceptance of the new paradigm. These phases are repeated cyclically (Kuhn, 1962).

For example, the Cultural Paradigm had a particularly important first phase, which we could call "Age of the Reason": Descartes (1596-1650), Newton (1643-1727), Laplace (1749-1827) had the merit of imposing the scientific method with the so-called "Linear Thought". Today we call it the "Reductionist Model": in Medicine this corresponds to the concept of disease considered as an isolated and incidental event.

But in the last century the second phase of the cultural paradigm was imposed: Thought became "Complex Thinking", and it was the so-called "Age of uncertainty": Heisenberg (1901-1976) and Godel (1906-1978) were the first exponents of this new paradigm. In Medicine this corresponds to a concept of disease considered as part of a larger and interconnected whole.

The Systemic Vision

When we speak of Systemic Vision, we are referring to a philosophical, scientific, sociological, mathematical, pedagogical concept, and the list could go on. As does the list of exponents who, in addition to the two already mentioned, have contributed to enriching this paradigm continue: Henry Poincaré (1854-1912), Jean Piaget (1896-1980), Gregory Bateson (1904-1980), Alan Turing (1912-1954), Urie Bronfenbrenner (1917-2005), Fritjof Capra (b. 1939), Pier Luigi Luisi (b. 1938), Giorgio Parisi (b. 1948) to mention only the main ones. It is not even possible here to mention what role each of them played in building systemic thought: we can think of each as the indispensable tile in composing a mosaic rich in colors and figures. Soon the contribution of cybernetics, the discipline that studies processes concerning «communication and control in the animal and the machine» (Norbert Wiener, 1894-1964), was also added (Wiener, 1948). Finally, it came to coin the term "Complexity Theory" thanks to the insights of Edgar Morin (b. 1921), (Morin, 1977, 1982, 1985), Ilya Prigogine (1917-2003) (Prigogine, 1985) or, in Italy, by Gianluca Bocchi (1985) and Mauro Ceruti (1985).

Complex is not synonymous with complicated, and simplicity is only one aspect of complexity (Baldoni, 2010, 2024). A complex phenomenon is more understood by what we do not see and cannot describe than by its clear evidence. According to Edgar Morin:

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a) To study complex phenomena without distorting them with arbitrary simplifications, it is necessary to study these phenomena in their environment.
b) Complex phenomena always depend on their observer. Scientific research, therefore, does not involve knowledge of an absolute and immutable reality (this concept derives from second-order Cybernetics).
c) Every complex phenomenon is by its nature organized, so it takes on the characteristics of a system.
d) According to the complexity paradigm, the most useful way to understand the world is through a "network of theories", which allows us to place ourselves, as appropriate, within one point of view or between one point of view and another, when this is useful. Relationships are not linear. So, fundamental is the ability to tolerate doubt, ambiguity, contradiction, the coexistence of opposing terms such as oneness and dualism, disorder and organization.

The definition of complexity is obviously not simple. Linear reasoning considers the various factors as a relationship of cause and effect in sequence: each factor is effect of another factor and cause of a third factor. But the reality is quite different: today we know that the world is made up of different elements which influence each other continuously. This also applies to the human person constituted by body/soma, mind/psyche and soul (meaning with this term any declination of spirituality, any sense of the sacred). It applies to the entire ecosystem.

It seems appropriate at this point to recall a central aspect of science: the concept of causality, moving from linear (Aristotelian) to multifactorial (common to 20th century medicine) to circular (introduced by general systems theory and cybernetics) and complex (allowing causal relationships to be considered from different perspectives) (Baldoni, 2010, pp. 27-34).

To get a vague idea, it can be helpful to think about the game of chess where on the board insist 32 pieces with different possibilities of movement and action: this can actually give an idea, although simplified, of the situation in real life, in the world today. It is not a coincidence that today, in some educational institutions, the game of chess has become a teaching course. Complexity cannot be eliminated: we must know it and then be able to manage it. Depending on our ability to manage what was previously a difficulty can become an opportunity. The classic example is that of the surfer: the waves of the rough sea become an opportunity for fun and adrenaline thrill. Even sailing can be a valid metaphor: strong wind, in expert hands, can turn into a rewarding sport full of satisfaction.

Literature on this subject is obviously rich, often in the form of books rather than scientific publications. For those who would like to study more carefully, by way of example, we cite two books by F. Capra written each with a different co-author. In the first, the authors propose a different philosophy from the so-called "Decrescita

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Felice" ("Happy Decrease") focusing instead on a Qualitative Growth, and where, among other things, you can read: «The view of the human body as a machine and of the mind as a separate entity is giving way to a view which interprets not only the brain, but also the immune system, bodily tissues and even each cell as a living cognitive system» (Capra *et al.*, 2013). The second book proposes a summa of Systemic Vision ranging from physics to biology to medicine (Capra *et al.*, 2017).

The biopsychosocial model

So far, we have dealt with the subject of complexity from a general point of view. But more particular and sectoral aspects can and must also be seen from a systemic perspective. For example, think to the so-called "War against cancer" which years ago was too simplistically proclaimed by the President of the USA. This technical and scientific aspect has revealed that it is characterized by considerable complexity: already in 2014 were listed ten medical cancer therapy modalities (excluding surgery and radiotherapy) that could interact synergistically but also antagonistically. And certainly, the current advances in medicine today, with the implementation of therapeutic choices, make this complexity even greater. Therefore, the choice between one type of therapy and another must be increasingly carefully considered, in case of relapses of the disease, also the consequences that this choice could have on subsequent treatment possibilities (Hanahan, 2014).

Until now, Medicine has been inspired by the "biomedical" model, which is based on linear thought and a disease-oriented doctor-patient interpersonal relationship. In practice, care of the sick person was analyzed in successive stages almost separate from each other: clinical history, diagnosis, prognosis, therapy, and rehabilitation. Nowadays, this model should be replaced by the "biopsychosocial" model proposed by George Engel (1977), based on systemic theories and a person-centered relationship between the medical team and the sick person, which, together with biological and organic factors, also recognizes the important role played by psychological and social determinants of health.

This model is particularly important in the most sensitive patient groups such as pediatric and elderly patients. Biopsychosocial model means holistic approach, anthropocentric vision (no longer the disease at the center, but the patient, or rather the citizen, the human person), real integration of Medical Humanities with Technological Medicine. It is important to recognize that, if the doctor is the expert on diseases and health techniques, the patient has an equal role, as an expert, just unique, of "his" person, of "his" disease, of "his" expectations. One last aspect must be highlighted in this model: there is no longer a simple doctor-patient relationship, but the doctor is now always part of a multiprofessional team (doctors,

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nurses, administrative, volunteers, etc.) and multidisciplinary (collaboration with psychologists, laboratory technicians, anatomical pathologists, organ specialists, etc.): in practice, while the figure of the reference doctor and often the case manager remains important, the patient's relationship is with the whole team, which is also, in practice, responsible, even as a collective, towards the individual consumer/ patient. But also the latter is in reality no longer alone: the family is also becoming increasingly important, both as partners in decisions that are more often shared by the sick person, including with relatives (of course, if he wishes), both as a caregiver and as an important part of care, especially in particular situations such as palliative care and home care (Santosuosso, 1998).

Moreover, in many cases a patient is not able to characterize his condition as a true disease or rather a general life problem, and even the doctor cannot make an exact distinction. Is pain, for example, a symptom or an illness? Psychological, cultural and ethnic aspects strongly influence the perception and communication of pain. The same applies to conditions such as asthenia, fatigue and depression. Since Sigmund Freud published his studies, medicine has developed new branches including psychoanalysis, psychobiology and psychosomatic medicine, with new related interpretations of organic diseases such as gastric ulcers, bronchial asthma and even cancer. But today we increasingly know that there is reciprocal and bidirectional contamination between the organic sphere and the psychological one, so it is wrong to analyze one of these two worlds without taking into careful consideration also the other.

The proposal of this biopsychosocial model is not very recent: today it begins to be known and applied but not as much as would be desirable (Engel, 1977; Bottaccioli, 2024).

In summary, the biopsychosocial perspective starting from systemic assumptions, considers diseases as a result of the complex interaction between factors that distinguish not only different systems (genetic, biochemical, cellular, tissue, metabolic, immunological, psychological, relational, social, environmental), but also levels of different systems (from the molecular to the macrocosm) (Baldoni, 2010).

Perhaps the biopsychosocial model may today seem reductive because it does not take into due consideration some aspects, for example the spiritual dimension. As Susanna Bianchini says «Also the spiritual dimension is an aspect that concerns the life of the human being, meaning by spiritual a constant and dynamic process of care: of one's own inner harmony, of the coherence of life with its own value system and of the relationship with its own soul and with the afterlife. It is a dimension anthropologically studied and that highlights how the theme of spirituality is relevant, since it is considered one of the predictors of psychological well-being, therefore also of mental health» (Bianchini, 2024).

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The Biopsychosocial paradigm has rightly influenced other approaches: for example, the new WHO Guidelines (2023) on the comprehensive treatment of chronic low back pain (Barsotti, 2024).

For a long time, medicine was based on the reductionist model: too much time. The genetic reference of J. Monod for a long time has represented a way of interpreting reality which, based on the model of Molecular Biology by Francis Crick, gave us at the same time security and protection (Monod, 1970). But, as we said at the beginning, T. Kuhn soon convinced us that paradigms go periodically into crisis and must be updated and replaced by new paradigms (Kuhn, 1962).

The PNEI Paradigm

It is at this point that the PNEI (psychoneuroendocrinoimmunological) paradigm is placed: his novelty is basically to combine systemic vision and integrated clinical philosophy, with scientific demonstrations of biochemical and biomolecular order.

A fundamental change has been, and continues to be, represented by modern Immunology that, going beyond the concept of *Self* and *Non-self*, presents the immune system as the strategic regulator between our organism and the whole galaxy of microbes (bacteria, viruses, fungi) that colonize our intestines first of all, modulated continuously by the environment, food, drugs, stress. From this point of view, immunology is a bridge organically linking biology and philosophy, two branches which until now have spoken two different languages while ignoring each other (Bottaccioli, 2022). And this is supported by the demonstration that the nervous system and the immune system communicate with each other using the same molecules.

Against the current trend towards more technological medicine, and enthusiastic about research increasingly oriented towards computer science and artificial intelligence, the PNEI paradigm is fully integrated into the philosophy of Systemic Vision applied in clinical practice. It involves attention to analysis, but within the holistic vision. Only with the PNEI paradigm it is possible to see at work the systemic vision, which goes from the affirmation of some general principles (not only Engel but also F. Capra) to the definition of a new pathophysiology and a new integrated treatment. The revolutionary idea of the PNEI paradigm lies in keeping together molecular biology and systemic vision of life, a vision that is therefore rooted in science. It does not remain on the humanistic level, where it does not interfere with biomedicine (just see the zero effect of the so-called Medical Humanities on training in medicine), but works to restructure from the bottom up the life sciences (humanities and biomedical). This is because it is a philosophical and sci-

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entific paradigm or, in other words, it is a philosophical paradigm based on science, meaning by science everything that increases verifiable knowledge.

It is important to add that the sciences of care must respond promptly and adequately to the epochal changes taking place. With the advent of Artificial Intelligence and Machine Learning (literally the machines that learn by themselves), today's medicine seems to be facing not so much a great opportunity as an extreme danger. The risk is clearly what already in the 18th century Julien Offray de La Mettrie had synthesized with the name of "*L'homme machine*", describing human physiology as the result of mere activation of mechanical devices. Even the advent of the Medical Humanities did not have much impact on the technological conception of cure. And this is because the two worlds continued to live separated as two rails that they go on, perhaps far away, but without really interfacing.

The great merit of the PNEI paradigm has been and continues to be that it is a bridge between the two approaches, a bridge not only philosophical but based on scientific achievements demonstrated at the biological and chemical level. Thus, the new PNEI paradigm knows and cares for the human being in its entirety, identifies the social and environmental determinants of health, orients molecular research within the systemic vision of the human being, and finally promotes empathy between patients and health care providers.

Let us for example examine the Stress Theory by Hans Selye. His brilliant idea, with the fundamental role of stress, remains confirmed even after many years. But as always happens, there are no longer only cortisol and catecholamines to regulate the body's response: reality is much more complicated, indeed complex. The allostatic load is modulated by a whole series of pro-inflammatory and anti-inflammatory cytokines functionally interconnected into a network of mutual regulation (Bottaccioli, 2017).

An essential element of the PNEI paradigm is the microbiota-gut-brain axis, which would be better described as microbiota-gut-brain-mind axis. Generally, we speak of the "microbiota-gut-brain" axis to connote all possible interactions between these three fundamental systems of the human body (and not only human). Within this definition someone proposes to add, referring to the human context, also the term "mind" because it is not reducible entirely to the neural level as well as each other term of the expression "microbiota-gut-brain" is not entirely reducible to the molecular physico-chemical level of its composition (Agnoletti, 2023).

One possibility that will certainly have a great development of research in the future is that of *Animal Experimentation* and its alternatives. Beyond the right considerations of ethical and bioethical order, even science today realizes that animal testing based on the man-machine model is no longer acceptable: already today there are alternative methods, which will be implemented soon. Consider the use

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of imaging (CT, PET, MRI, etc.) and new in vitro methods. A very promising alternative for research into metabolism and toxicokinetic of substances is the use of "organoids" from human tissues, which, using 3D stem cell cultures, simulate the various organs of the human body (Bottaccioli, 2017).

It is interesting how, starting from the analysis of Engel, with its biopsychosocial model, the PNEI paradigm manages to treasure also modern scientific achievements. For example, by incorporating the insights of Carlos E. Sluzki, and integrating neuroscience, genetics, mind, and the social world into a complex of systemic formulations with profound implications for training, practice, and research in the field of family processes and therapy in general. According to this theory, social networks influence biogenetic networks, and, at the same time, the neurobiological system influences the social world and communities. In the light of this co-evolution, the therapist must consider all these processes of adaptation in an integrated vision, and in continuous development, of the human being under the biological, psychological, and social aspect (Sluzki, 2007).

In summary, the biological and cultural revolution of the Third Millennium has led to the birth of profound changes in many approaches and different skills to take care of the human being in all its complex dimensions. Doctors, physicists, biologists and physiologists have seen the appearance of profound changes not only linked to increasing scientific results, but also, and especially, related to new scientific bases in a systemic perspective that transcends the watertight compartments of the different branches and subjects of knowledge and action (Bottaccioli, 2011).

It has been shown that even branches which appear far removed from medicine, such as architecture, can have an important influence on the psycho-neuro-endocrine immunological system (Moneti, 2022).

Complexity and Ecology

The biopsychosocial model, which is still valid today from the point of view of the relationship between physician and patient considered in an expanded context as we have seen to the family and social situation, must evolve today into a model that takes into account the fact that it is now well known that both patient and physician are organic parts of the biosphere. We could call this form of evolution the «ecological model» (Palazzo, 2013).

The "Ecological Model" is biosphere-centric: attention is therefore not only focused on the sick patient or the healthy citizen but must consider the entire Biosphere and the consequences that the doctor's choices may have on it. Therefore, this model needs a Community of Practice, composed of all the operators, but also with the presence of patients' representatives, which implements eco-responsible

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choices on the potential current and future impact on the human and social environment, and the biosphere.

Meanwhile, we must note the end of anthropocentrism, a concept that has accompanied us wrongly, and here the Catholic Church has played an important role for a long time, too long. The first injury to man's narcissism came a long time ago when Copernicus demonstrated that the Earth was not at the center of the Universe. The second humiliation (the term is from S. Freud) came from Charles Darwin who demonstrated the ineradicability of the animal nature from man. The third came from Sigmund Freud himself, who proved that the self is not master in his own house (Freud, 1916). Finally, the coup de grace was the techno-digital one, with Alan Turing demonstrating that humans are not "alone" to think (Floridi, 2020).

It seems pleonastic to point out that we must not confuse this "ecological" model with what Bronfenbrenner stated when he published his Ecology of Human Development (1979): when he describes his theory of ecological systems, distinguishing different levels of systems (micro-, meso-, exo- and macrosystem) he looks specifically to the family, the school environment and society (Bronfenbrenner, 1979).

In summary the Ecological Model must try to reduce the "Ecological Footprint" (that is the damage to the environment, measured as production of CO2, etc.) for which we are responsible as physicians, just as we are already trying to do as citizens, ordinary men and women (Bonaldi, 2023).

Of course, we must remember that the priority remains the well-being of the patient and the search for the most effective treatment, but in a vision which takes seriously into account the vital and environmental needs of the biosphere.

From these premises was born the concept of "One Health". The One Health approach is a type of holistic methodological approach, which consists in considering the global health of the planet as important as that of individuals: therefore, it proposes to address to the problems with interdisciplinary collaborations. One health = human health + animal health + environmental health. The One Health definition was coined in 2004 at a conference called by the Wild Conservation Society (Manhattan Principles). Initially it was applied mainly to animal health, food safety, zoonotic epidemics, and antibiotic resistance. Today, this approach also takes careful account of a) the pollution of natural resources and the destruction of biodiversity; b) urban planning and spatial, productive and transport planning; c) exploiting the potential of technology and information technology to safeguard the integrity of the planet. In summary "One Health" is a systemic approach aimed at protecting all forms of life on Earth because every life is essential to maintain the balance of the ecosystem: every form of life is useful for the health of other living beings. In summary: a single "HEALTH" (Editorial Lancet, 2023).

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Other paradigms

As a result of all these acquisitions, other paradigms have also been born in addition to the PNEI paradigm.

For example, the Slow Medicine movement, a new way of considering health and care, was born in 2011. Founded on a systemic, Network vision, it aims to be a new paradigm, a path of comparison between different approaches to care, meaning by this term more the care and the healthcare than the merely therapeutic side (Bert, 2018) (https://www.slowmedicine.it/). One of the key words of Slow Medicine is respect for Appropriateness. In healthcare, appropriateness refers to the correct use, based on scientific evidence and clinical guidelines, of an effective intervention, delivered to the right patient, in the most appropriate way and at the right time, minimizing risks and maximizing benefits (Bobbio, 2017).

Some medical specialties have carried out projects that consider the care and therapeutic aspects from a perspective of systemic vision and environmental sustainability.

For example, the Italian Society of Nephrology has the objective of reducing the ecological footprint of therapies, and in particular dialysis, by saving water, energy, and sustainable waste management (Piccoli, 2020).

Similarly, the CIPOMO (Italian Primary College of Medical Oncology Hospitals) has formed the working group "Green Oncology" with objectives of economic and environmental sustainability (Palazzo, 2010; Bretti, 2014). The experience of Integrated Oncology, while requiring further scientific confirmation, represents a further approach in this direction (Baccetti, 2015).

Following this perspective, which looks in particular to what we have called "ecological model", we cite the experience of the group of US anesthetists of GAIA (Green Anesthesia Initiatives), which have demonstrated how care can be taken with regard to the environmental impact without harming the health of the patient (Colquhoun, 2025).

But the experiences in this field of interest are numerous: for instance, we recall one more. The "Complexity Institute", although mainly interested in the world of business and management, is also committed to health: consider the publication of the book "The complexity of an epidemic" at the time of the COVID pandemic (https://www.complexityinstitute.it/).

Even an apparent simple topic such as nutrition/diet must be seen today from a systemic perspective. Today we know that the agro-food chain includes several stages: production, distribution, consumption, and waste (including compost). It has close correlations with Economy, Land use, Environment, Health, Work, Chemistry, Social aspects, Culture. And we know that each of these themes com-

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prises many other subsystems. A new name has therefore been born: "Agroecology" (Wezel, 2009).

As a conclusion to this short list, we would like to mention psychosomatics: this approach, in a complex conception, is actually proposed not so much as a new paradigm but as a metaparadigm, in the sense that it allows the adoption and integration of different paradigms while accepting any differences and paradoxes (Baldoni, 2010).

The role of SIPNEI

SIPNEI (Society of Psychoneuroendocrineimmunology) has since its birth made a careful study, with its theoretical consideration and research, of new or little explored by the official Medicine territory. Examples include Microbiota and correlations with brain functions and psychiatric pathologies (bowel-brain axis); Epigenetic, (*Pnei Review*, 2023); Lifestyles; Low-grade chronic inflammation; Endocrine disruptors; Therapeutic techniques inspired by oriental culture (relaxation, meditation, acupuncture, plantar reflexology, yoga, Tai Chi, etc.) (Galfano, 2025); Sexuality, Gender and Identity (*Pnei Review*, 2024).

The author does not have the ability to predict, but believes that the challenge will continue in the future in the study of situations still frontier, where a multidisciplinary and multi-professional approach is required, such as: a) Exposome and green prescriptions (Piras, 2021); b) Bioethics; c) Climate Control and Ecological Footprint (Petersen, 2025; Bologna, 2023). But certainly, future projects will also look at other areas of interest and clinical and basic research.

In our opinion, in this activity SIPNEI must continue to move within the challenge of law 833/78: equal treatment for all patients, that is the right to free and universal health care.

Final considerations

Medicine, when referring to clinical aspects, does not necessarily have to be the same for everyone. Otherwise, an algorithm, a robot, the Artificial Intelligence (AI) could be enough. («There is no greater injustice than to make equal parts between inequalities», Scuola di Barbiana, 1967).

In this sense we can hope for a Medicine that is called of the 4P: Precautionary (Preventive), Participatory, Personalized, Predictive (Hood, 2013).

But only on the condition that it will not a merely digital, computer-based Medicine, prostrate facing the idol of Artificial Intelligence.

We believe that the possible fifth P of Precision needs to be looked at carefully,

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with great caution, if not mistrust. No one denies the benefits of genetic diagnostic kits or monoclonal antibodies for immunotherapy or similar. But the perplexity comes from the risk of losing the concept of the Person as a biological/psychological individual (soma + mind) that only a holistic vision, as we have argued so far, can guarantee. A kind of fatalism would reduce commitment to lifestyles and those determinants of disease/health that are the etiopathogenetic basis of the diseases of this century (Bonaldi, 2018).

In conclusion, the current global situation of conflict and social fragility in many populations makes essential and urgent to have a comprehensive approach that simultaneously guarantees access to care, respect for human rights and economic and financial compatibility: this applies to a serious and widespread disease such as cancer, but this is not true just for the planet cancer (Casolino, 2025).

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