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Naomar Almeida-Filho

# Towards a Unified Theory of Health-Disease: I. Health as a complex model-object

## Para uma teoria unificada sobre saúde-doença: I. Saúde como objeto-modelo complexo

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### ABSTRACT

Theory building is one of the most crucial challenges faced by basic, clinical and population research, which form the scientific foundations of health practices in contemporary societies. The objective of the study is to propose a Unified Theory of Health-Disease as a conceptual tool for modeling health-disease-care in the light of complexity approaches. With this aim, the epistemological basis of theoretical work in the health field and concepts related to complexity theory as concerned to health problems are discussed. Secondly, the concepts of model-object, multi-planes of occurrence, modes of health and disease-illness-sickness complex are introduced and integrated into a unified theoretical framework. Finally, in the light of recent epistemological developments, the concept of Health-Disease-Care Integrals is updated as a complex reference object fit for modeling health-related processes and phenomena.

**DESCRIPTORS:** Models, Theoretical. Health-Disease Process. Comprehensive Health Care.

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### RESUMO

A elaboração de teorias constitui um dos desafios mais cruciais enfrentados pela pesquisa básica, clínica e populacional que forma as bases científicas das práticas de saúde nas sociedades contemporâneas. O objetivo deste estudo é propor uma teoria unificada da saúde-doença como ferramenta conceitual para a modelagem da saúde-doença-cuidado à luz de abordagens da complexidade. Discute-se a base epistemológica do trabalho teórico no campo da saúde bem como conceitos relacionados à teoria da complexidade aplicada a problemas de saúde. Em segundo lugar, os conceitos de objeto-modelo, multi-planos de ocorrência, modos de saúde e complexo doença-enfermidade-moléstia são introduzidos e integrados numa estrutura teórica unificada. Finalmente, à luz de desenvolvimentos epistemológicos recentes, atualiza-se o conceito de integrais de saúde-doença-cuidado como um complexo objeto de referência ajustado para a modelagem de processos e fenômenos relacionados com a saúde.

**DESCRITORES:** Modelos Teóricos. Processo Saúde-Doença. Assistência Integral à Saúde.

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## INTRODUCTION

The British Medical Journal recently published a report on the limitations of current health concepts, proposing a definition of health as “the ability to adapt and self manage in the face of social, physical, and emotional challenges”.<sup>49</sup> In the same relativistic vein, Campos<sup>28</sup> argued that conceptions of health as a general label, although applicable to different situations, states and processes, do not account for the wide diversity of socio-cultural contexts. Scholars from several scientific fields have emphasized the need for theoretical work on the health concept as a crucial effort to promote effective interventions in concrete health-disease situations.<sup>35,39,40,54-56,75,76</sup>

Time seems ripe for evaluations of philosophical, scientific, political and pragmatic implications of the health concept, as a key topic in contemporary research agendas. Unfortunately, since Canguilhem's<sup>29</sup> and Dubo's<sup>37</sup> classical contributions to pathological and ecological models of disease, not enough investment, institutional and intellectual, has been devoted to theorizing about health-disease phenomena. Reviewing the biomedical literature, Jadad & O'Grady<sup>50</sup> found 2,081 papers citing definitions of health; of these, only a handful addressed specifically conceptual aspects.<sup>21,25,27,55,69</sup> A few attempts in this regard, such as Stempsey's<sup>71</sup> pathological view of disease or Gammelgaard's<sup>43</sup> evolutionary biology perspective, have resulted in reductionist, narrow models of disease and health. Exceptions are Boorse<sup>20-22</sup> and Nordenfelt<sup>62</sup> who proposed comprehensive approaches for health as a theoretical concept. Despite remarkable insights, the contribution of these authors is still limited by their account of health as a linear object of knowledge, defined as the absence of disease. Indeed, theory building is one of the most crucial challenges faced by basic, clinical and population research, which form the scientific foundations of health practices in contemporary societies.<sup>54</sup>

For the past 15 years, colleagues and I have developed a conceptual framework for modeling health in the light of complexity approaches.<sup>2-15,33</sup> Results from this line of theoretical research allowed preliminary proposals of a Theory of Modes of Health<sup>8</sup> and the concept of Health-Disease-Care Integrals.<sup>6</sup> This paper is the first of a series of essays intended to advance, revise, correct and abridge updated versions of such proposals, as well as to assess feasibility and possibilities for the integration/convergence/fusion of these approaches into a unified theory of health-illness-sickness. Initially, I will introduce some concepts related to complexity theory as concerned to health problems. Secondly, a brief account of the epistemological background of theory building in the health field will be presented. Third, I will revise the notion of modes of health as key to a conceptual

framework for modeling health-related processes and phenomena as a complex reference object. Finally, in the light of further theoretical developments, I propose to update the concept of Health-Disease-Care Integrals.

Beforehand, a preliminary epistemological distinction is needed. The basic difference between a general theory and a unified theory is that the former is postulated as an all-encompassing structure of explanations, valid for different levels and contexts, in contrast to a unified theory, which integrates complementary, non-exclusive modes of understanding, called “special theories”. Special theories are partial, restricted explanatory models of specific objects of research. General theories typically cover the totality or integrity of given fields of knowledge. Unified theories address the plurality of facets of complex objects, thus harmonizing special theories, or different scientific approaches, into a given interdisciplinary problem. These terms were introduced along the debate on the validity of relativity theory in Physics<sup>46</sup> and later on adopted for defining the general systems theory.<sup>35,51</sup>

## EPISTEMOLOGICAL BACKGROUND

Post-Cartesian scientific paradigms have promoted theoretical approaches and methodological devices more effective for tackling real-world complex problems.<sup>19,23,45,47,72</sup> This set of concepts and methods has been designated as complexity theory.<sup>38,44,59,60</sup> Although fashionable as a new strategy for producing knowledge in contemporary science, complexity theory is not new. It is a direct evolution of General Systems Theory,<sup>64</sup> a remarkable conceptual framework influential in the scientific panorama during the 1960s.<sup>23,35,74</sup>

In this perspective, scientific enquiry implies the construction of models. Like maps, models are useful as guides for traveling through unexplored territories of reality.<sup>58</sup> In this sense, models are not direct representations of an absolute reality but result from a reduction of selected traits of concrete phenomena into universal categories.<sup>41,45</sup> Such categories are expressed as concepts, proposed for referencing objects of knowledge.<sup>19,26</sup> Contemporary philosophers of science, such as Godfrey-Smith<sup>45</sup> and Bhaskar,<sup>19</sup> justify a distinction between concrete objects and conceptual objects. However, the concrete object of a given scientific field may well be totally non-tangible, such as ‘energy’ for thermodynamics, ‘market’ for economics or ‘risk’ for epidemiology. To account for this type of conceptual device, Minsky proposes the terminology “object-symbols”, as opposed to “object-things”.<sup>58</sup>

According to Bunge,<sup>26</sup> concept building means construction of cognitive artifacts drawn by reference to the

concrete world, or model-objects. Model-objects can be either ontological or heuristic models. Ontological models are analogical devices for the reference of a given category of being, while heuristic models are explanatory devices of the determination or functioning of the object. Homeostatic systems are examples of ontological models; biomolecular causal models of disease are heuristic model-objects. Epistemologically speaking, symbolization processes (and the construction of meaning) are at the basis of such theoretical models, a necessary condition for stability, testability and communicability in science. When put into a larger context of explanation, model-objects may be called theories, or reference models according to the Bunge-Wand-Weber approach.<sup>41</sup>

The epistemological questions pursued herewith relate to a central problem of complexity thinking: how to integrate diversity of layers of comprehension and plurality of planes of emergence in a multi-level, multi-faceted object of knowledge? In other words, how to deal with a complex object that is simultaneously one and many, part and whole, parcel and totality, singularity and plurality?<sup>60</sup>

Complex model-objects must be conceived with distinct facets and multiple dimensions, leaving room for the recognition of various planes of emergence, structural and functional hierarchies, and simultaneous levels of integration in complex adaptive processes. The phenomenological domain defined as the empirical field of a given science can be modeled in terms of complexity theory with planes of emergence, layers of occurrence or “levels of anchorage”.<sup>67,68</sup> Also, the notions of non-linearity and emergence are crucial to identify complexity in dynamic systems.<sup>38</sup> These are grounds for conceptually setting up hierarchical orders of complexity, with varied degrees of specificity related to objects of investigation that typically imply plural, unstable, uncertain, dynamic connections, events and processes.

Complex models are plural, multi-modal, multi-level, hierarchical, non-finalistic, non-linear, simultaneously iterative and interactive, including emergence in its explanatory network of multiple elementary forms of determination. To use an example from the health sciences, synergic effects of risk factors, produced by interaction processes, may be taken generally as sources of emergence in epidemiological systems.<sup>6-11,31,70</sup> In a study of gender, social class and race/ethnicity on prevalence of depressive disorders,<sup>14</sup> gender followed a pattern, confirmed in different studies worldwide: women’s risk for depression is twice as high as men’s. Social class and race/ethnicity alone yielded low-risk estimates. Taking all factors together, the sum of isolated effects of gender, social class and race/ethnicity would be roughly 4,6 (= 2.0 + 1.6 + 1.0, respectively). The actual odds ratio found in the data analysis was

double than expected: the risk for depression was 9-times higher for poor black women as compared to wealthy white men. Although unpredicted or unexplained by the model, the surplus-effect that emerges out of the internal structure of the data set (which is a concrete referent of the research process) and its occurrence cannot be denied or suppressed.

For Samaja, health is an object classified as what he calls “complex systems with history”.<sup>68</sup> Thus, the interdisciplinary field of the health sciences is structured upon cognitive production of diverse subordinate objects, revealing different levels of emergency along three hierarchical interfaces: molecule-cell, cell-organism, organism-society.<sup>68</sup> Since the human organism, as a social body, is a product of complex processes of exchange with the environment and with society, and to the extent that these processes contribute to determine phenotypes, the health concept would correspond to a fuzzy model-object cutting across the biological sphere of living organisms, the mode of life of human subjects and the perceptions and feelings of sick and healthy people.

From such preliminary epistemological foundations, it is possible to briefly consider the accumulated heuristic potential in the interfaces of biosciences, social sciences and health sciences, providing objective conditions for a proposal to systematize the problem of health as a complex concept.<sup>1-3,11,31,44,68,70</sup> In this regard, selected forms of the ‘health’ concept can legitimately subsidize an ontology of health as a scientific model-object under the Bunge-Wand-Weber theorem,<sup>41</sup> shaping descriptors capable of empirical reference.

## THEORIES OF DISEASE, NOT OF HEALTH

In analogy to opposing notions of life and death, Christopher Boorse<sup>20-22</sup> conceived a biological concept of health as absence of disease, proposing what he named a “biostatistical theory of health”. His approach was based on four concepts: ‘normal function’, ‘reference class’, ‘disease’, and ‘health’. Normal function is defined as what is “statistically typical” in relation to the reference class for the species’ survival and reproduction. A reference class consists of the universe of members of a biological species of the same sex and age group. Disease is a reduction in the “typical efficiency” involved in the normal function of members of a reference class. In Boorse’s approach, health equals to normalcy, always “in the sense of the absence of disease conditions”.<sup>20</sup> The logical opposite of the disease concept would be theoretical (or conceptual) normalcy. For Boorse, there are three types of normalcy: theoretically normal, diagnostically normal, and therapeutically normal. The respective antagonists would fit with the other levels of normalcy: diagnostically abnormal and therapeutically abnormal.<sup>20-22</sup>

Kleinman, Eisenberg & Good<sup>52</sup> defined *disease* as a biomedical concept that refers to alteration or dysfunction in biological and/or psychological processes, *illness* incorporates individual experience and perception of disease, and *sickness* refers to the societal reaction to problems deriving from both disease and illness. In this perspective, organs or physiological systems can function pathologically regardless of its recognition or perception by the individual or by the social environment. Young<sup>77</sup> contends that the distinction between disease and illness in Kleinman-Good model is insufficient to account for the socio-political dimensions of the process of becoming ill. To overcome these limitations, Young proposes to replace the scheme [sickness = disease + illness] with a triple series of categories in equivalent hierarchical levels (sickness::illness::disease). Kleinman<sup>53</sup> partially revised this originally objectivist position, contending that both disease and illness are social constructs. Thus, one must consider different models capable of conceiving health and illness as resulting from the complex interaction among multiple factors at the biological, psychological, and sociological levels, with a glossary not limited to biomedicine.<sup>16</sup> Despite its interpretative sophistication, the Kleinman-Good-Young disease-illness-sickness (DIS) model is congruent to Boorse's biological theory of health as absence of disease.

Bibeau & Corin advanced an anthropological framework to study local systems of meaning and practices regarding health problems, implying a dialogic view of the DIS model.<sup>17,18,34</sup> This framework was intended to connect different dimensions of reality, proposing a meta-synthetic approach to integrate interpretative and pragmatic elements for a cultural model of health-disease-care. According to these authors, popular semiology and cultural models of interpretation are plural, fragmented, and even contradictory, and do not exist as an explicit body of knowledge, but are formed by a varied set of imaginary and symbolic elements. Popular knowledge about disease and correlates (sickness in the DIS model) can be expressed and understood in terms of socially and historically constructed systems of signs, meanings, and practices of health.<sup>17,18</sup> Such systems are rooted in the group's societal and cultural values underlying the individual experience of falling-ill and the social production of sickness. In the general realm of symbolic production, biological, linguistic, and behavioral signs are transformed into symptoms of a given illness, acquiring cultural meanings and generating specific social reactions. In this broad perspective, relations between the economic-political context and its historical determination are explored as a social background for systems of meanings and the experience of embodied illness.<sup>34</sup>

Canguilhem produced an epistemological evaluation of biomedical knowledge with great potential for developing new theories in the health field.<sup>29,30</sup> For him, normalcy includes health and sickness to the extent that both imply a certain life norm. The threshold between health and sickness is singular, although influenced by cultural, socioeconomic and political instances that transcend the strictly individual dimension. Particularly concerned with concepts of health, Canguilhem<sup>30</sup> dwells with the Kantian conception of health being outside the philosophical realm, a common-sense notion or a private matter, so personal that could never become a scientific concept. This idea of health as radically private and personal has been also defended by Gadamer,<sup>42</sup> who thought that health cannot be measured because it implies deep personal inner processes. This author argues that, for its obscure character, health is an enigma; the mystery of health is equivalent to the mystery of life.

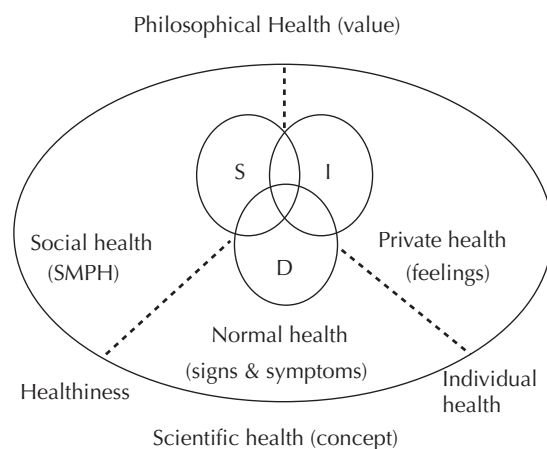
Canguilhem<sup>30</sup> would agree that "philosophical health" escapes the reach of instruments, protocols, and scientific methods, and overlaps subjective health. Yet health incorporates not only individual health, but also its complement, recognizable as public health (i.e., health made public). Referring to ethical and metaphysical health-related questions, this notion of public health would result in the notions of utility, quality of life, and happiness. As such, it moves away from the expert's idea of public health, which refers to the state of health of populations and its determinants, in two senses: as a complement to epidemiological concepts of risk and as reference to broader concepts of health.

## HEALTH AS PLURALITY AND TOTALITY

As seen above, Canguilhem's health concept refers to simultaneous, separate but articulated, planes of reality: in the genotype, in the subject's life history, in the human population and in shared relationships to the environment. Hence, while philosophical health in a sense encompasses individual health as a human right, it does not displace the possibility of measuring the health-related quality of life of human subjects. By analogy, the idea of philosophical health (e.g., health as a value, political or ethical) does not preclude taking health as a scientific object (health needs, epidemiological risks or population health). In this sense, scientific health would be public or collective health, that is, healthiness is constituted in opposition to the notion of sickness.

Figure 1 presents a scheme intended to merge Canguilhem's position and Kleinman-Good-Young DIS model. The DIS model (here drawn as a Venn diagram) occupies the graph center. The region of reality immediately related to the core-object gives some ground to the idea of health as complementary to the triple dimension of the disease-illness-sickness set. Normal health (Boorse's diagnosed normalcy) is





SMPH: System of signs, meanings, and practices of health

**Figure 1.** Canguilhem's Model (adapted).<sup>30</sup>

the complement of disease; private health (Gadamer's health enigma) is the complement of illness; social health Bibeau-Corin's system of signs, meanings and practices is the complement of sickness. In addition, the outer field, where both regions of the DIS Complex and the dimensions of health are contained, hosts other transcriptions of the health concept, to be defined ahead.

Considering the definitions of hierarchical interfaces and planes of emergence, a conceptual frame may be useful as a basis for integrating the contributions of health sciences and applied social sciences in a unified theory of health.<sup>6-8</sup> This framework (Table 1) organizes the terminology used for categories of non-health available to different health sciences, in addition to distinguishing between the varied definitions of normalcy and health and their potential empirical descriptors. It implies an effort to translate Canguilhem's model into the theoretical specifications of Modes of Health.

The scheme proposed is an expanded glossary of categories of health and non-health, which, in a sense, incorporates and articulates a semantic demarcation of disease-illness-sickness and the corresponding modes

of health. The various categories of non-health and health are organized according to hierarchical planes of emergence: sub-individual, individual, collective. Also, equivalent descriptors are indicated for the respective levels and planes.

On the subindividual and individual planes of emergence, at any level of complexity, the health object can be examined based on a deterministic explanatory approach, producing structured causal metaphors. In this case, the aim is to construe partial facets of the model-object Health as biomolecular processes in the normal systems or sustained physiological processes in healthy subjects, equivalent to pathological processes as manifested in a 'case' of a sick person. Thus, at the sub-individual level, normalcy and pathology (in the original Canguilhemian sense) correspond to the descriptor "state".

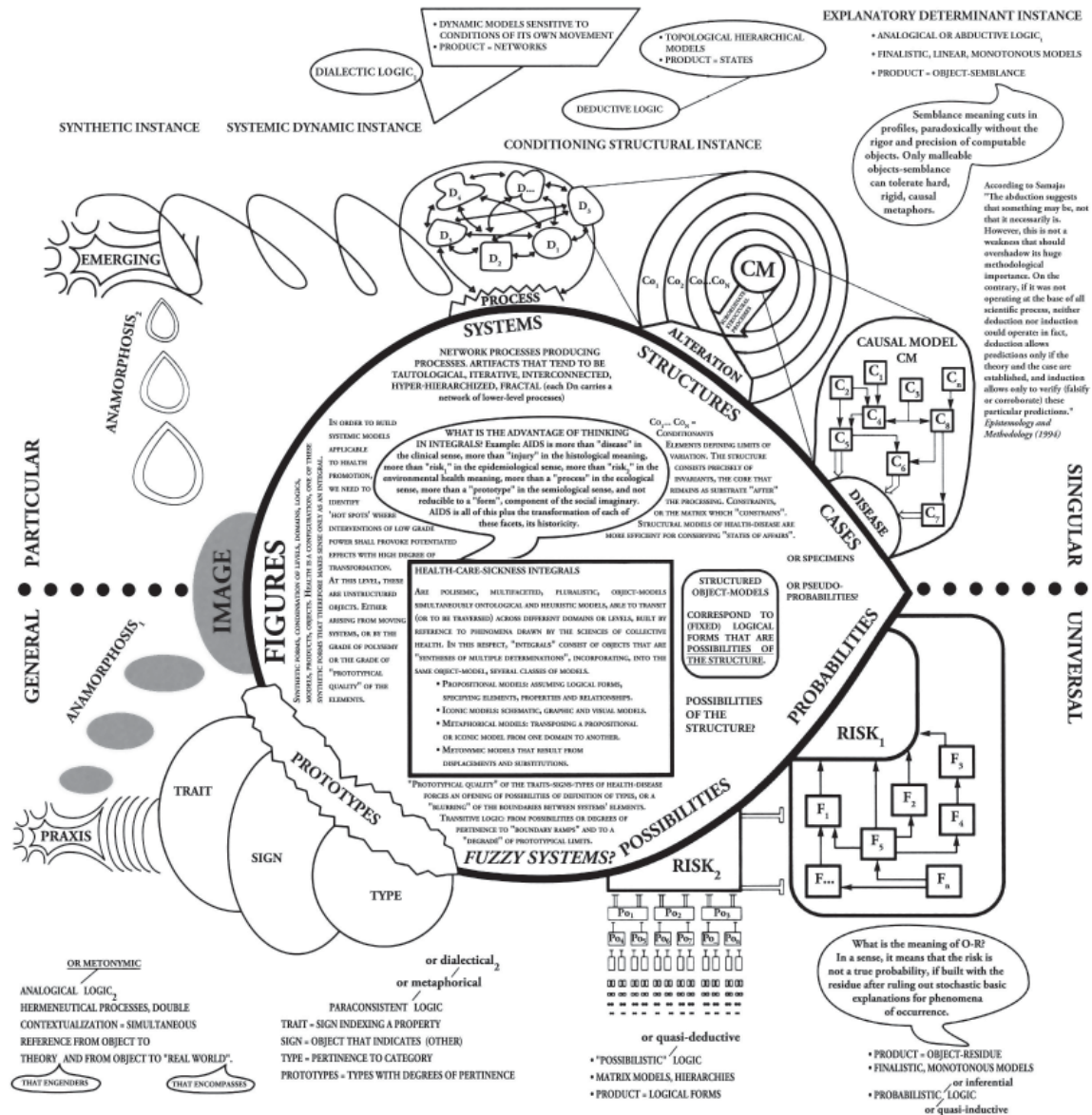
For the individual, in the clinical level, normal health corresponds to disease (structural) and disorder (functional), with "signs & symptoms" as descriptors. The category 'disorder' refers to a disease without structural (anatomy-pathological) lesion, which occupies a level equivalent to the definition of disease in the clinical sphere. Private health, as well as individual health, object of an "epidemiology of health",<sup>7</sup> corresponds to 'illness', defined according to Canguilhem's model. In the individual instance, the descriptor "health status" is used to objectify the person's mode of health, and "feeling" refers to the intimate, private mode of health that cannot be made public.

The conventional epidemiological perspective of risk factors may also be placed into this scheme at the population level. From this perspective, the health-disease object is reproduced as a specific concept, with risk-production models based on the direct action or interaction of risk factors. Quantitative epidemiological descriptors (rates, coefficients) can deal with the subset's counter-domain (of sick population groups), equivalent to the population residue  $[1 - \text{risk}]$ .<sup>7</sup>

The descriptor "health situation" corresponds to the notion of public health in Canguilhem, which may be

**Table.** Planes of Reality and Modes of Health.

Planes of emergence	Categories of non-health	Modes of health	Descriptor
Sub-individual	Pathology	Normalcy	State
Individual	Disease	Normal health	Signs & symptoms
	Disorder		
	Illness	Private health	Feeling
Supra-individual or Collective		Individual health	Status
	Risk	(1 - risk)	Measure
	Morbidity	Healthiness	Situation
	Sickness	Social health	Systems smph



DIS: disease-illness-sickness

**Figure 2.** Conceptual map of the DIS complex represented as health-disease-care integrals (Almeida-Filho,<sup>6</sup> 2000).

called 'healthiness' in contrast to the idea of morbidity in traditional public health discourse. Finally, the modes of "social health", which are equivalent to the concept of sickness in interpretative medical anthropology, could be approached through Bibeau-Corin's systems of signs, meanings, and practices of Health.<sup>19,34</sup> In this case, the theory provides the possibility of incorporating sickness into the health concept itself, to the extent that it takes the experience of sickness as a way of living by structuring the social representation of health as subjectivity through the subject's interaction with the material and symbolic worlds.

In sum, the scheme proposed herein may be read as an effort needed to build equivalences between concepts of health and the diversity of dimensions of disease. The basic conclusion of this argument is that health is plural, that is, it does not comprise a unique, universal, totalized category. Depending on planes of emergence and facets of the object at stake, to refer to "healths" or, more precisely, to various "modes of health" will be more respectful of the complexity of dynamic states and processes in the concrete health reality. The notion that the concept of health refers to a mutant, plural, relative and non-ontological object is not exactly new and original. Nietzsche,<sup>61</sup> back in 1882, wrote that:

“For there is no such thing as health in itself, and all attempts to define a thing in that way have lamentably failed. It is necessary to know your aim, your horizon, your powers, your impulses, your errors, and especially the ideals and fantasies of your soul, in order to determine what health implies even for your body. There are consequently innumerable kinds of health [...]”

An analogy drawn from meteorology may help to clarify this concept of a plural, integral, complex, synthetic, reference model-object: What defines a storm? Not barometric pressure, or wind speed, or rainfall, or temperature change (all of which may be measured with some degree of precision), nor electric bursts, or cloud concentration (which can be described and registered), but all these phenomena combined in an integral totality that is recognized as such and that cannot be reduced to its measurements or descriptions. Following this analogy, it may be said that the model-object ‘health’ is, like a storm, a complex construct that is definable only in its broader configuration, for it has different facets or angles, and that none of those angles by themselves give access to the object referenced in its entirety.

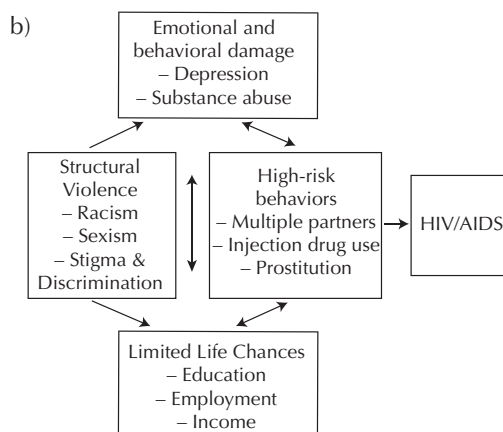
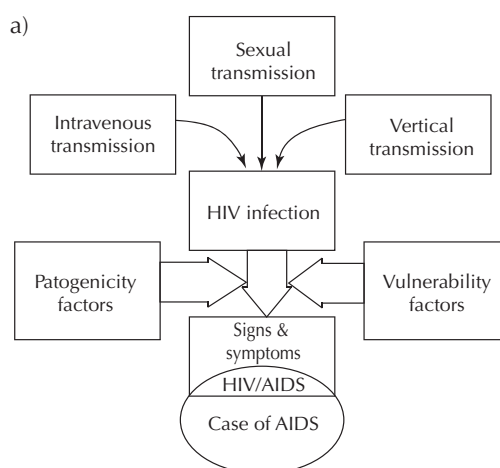
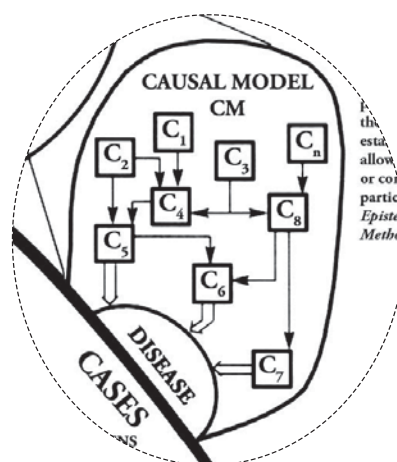
Along this line of enquiry, ‘health’ as a concept is marked by properties intuitively considered as antagonistic: plurality and totality. On the one hand, health-disease phenomena cannot be defined as exclusively a sub-individual biological effect or an individual-personal clinical issue or a social-environmental process.<sup>31</sup> A constructive scientific approach to the appraisal of health as complexity ought to incorporate Samaja’s contribution regarding multi-reality stances, which presents the concept’s explanatory structures as a heuristic model-object. Indeed, health objects are plural, multifaceted, transdisciplinary, simultaneously ontological and heuristic models capable of cutting across (and being traversed by) dimensions, spheres and domains referring to different levels of complexity.<sup>3,6-8,15</sup> On the other hand, to respect its integrity-totality, the model-object ‘health’ is crucially defined as a meta-synthetic theoretical device. In sum, oriented by complexity approaches, model-objects such as disease-illness-sickness – the DIS Complex – articulated with life-function reference objects, must be treated as a plural-total construct: the health-disease-care integral.

### HEALTH-DISEASE-CARE INTEGRALS

For Samaja,<sup>67,68</sup> the reference object called health, as a construct, entails a large number of hierarchical interfaces and an enormous amount of information, experiences and assumptions on normality/pathology, treatment/prevention, healing/recovery. In order to compose the rationale needed for integrating the broader theoretical scheme proposed, consider a series of basic postulates.

(1) The object health in general, in its complex, plural nature, is an integral totality that comprises sub-objects operating at different planes of reality.

(2) Health objects and sub-objects are reference to health-disease-care phenomena as complex systemic models.



**Figure 3.** Causal deterministic model-object illustrated by (a) a clinical-epidemiological model (Almeida Filho,<sup>a</sup> 2012) and (b) a HIV/AIDS social causation model (Poundstone et al,<sup>63</sup> 2004).



(3) Health-disease-care models are organized in three dimensions: domains, instances, and levels of complexity.

(4) The dimension of domains implies classical vectors of philosophical inquiry, from the singular to the universal and from the particular to the general.

(5) The dimension of heuristic instances comprises four modalities of basic models: explanatory, structural, systemic, and synthetic.

(6) The dimension of levels expresses different degrees of complexity in the organization of objects of knowledge, from the micro to the macro level.

One sick person or a diseased body or one particular health institution all belong to the realm of the singular and, as such, are specimens or singular cases of particular, general or universal reference objects. Endemic or epidemic occurrence of a disease and organization or structure of a health system in a given province both belong to the realm of the particular. Professional taxonomies or popular disease glossaries, health care historical contexts, cultural cosmologies, are manifested in the general domain. Cancer, immune-deficiency, risk, survival, health care (taken as constructs or theoretical categories) are pertinent to the universal domain.

Figure 2 represents a graphical synthesis of some of the critical topics of this paper, organized according to the assumptions pointed out above.<sup>6</sup> Despite being a sketchy, preliminary account of complexity in health-disease-care integrals, this model is intended to depict visually the major lines of thought underlying this proposal, oriented towards setting the baseline for a special theory of disease nested in an integrated or unified theory of health.

In the dimension of heuristic instances, several health-disease-care objects may be construed and articulated to form the DIS Complex. Causal models of disease in individuals and risk models in populations are explanatory heuristic instances, food chains and health systems are systemic models, biological mechanistic models and vulnerability processes are structural instances, descriptors of health situations and narratives of care itineraries are synthetic heuristic instances. The designation of such instances as ‘validation patterns’ is justified because they are subject to direct sources of conceptual validity, which are internal to particular paradigms and specific fields of scientific knowledge.<sup>67</sup>

As applied to health-related processes, the dimension of levels of organization is integrated as a complex of hierarchical inter-contained sets. Molecules, cells,

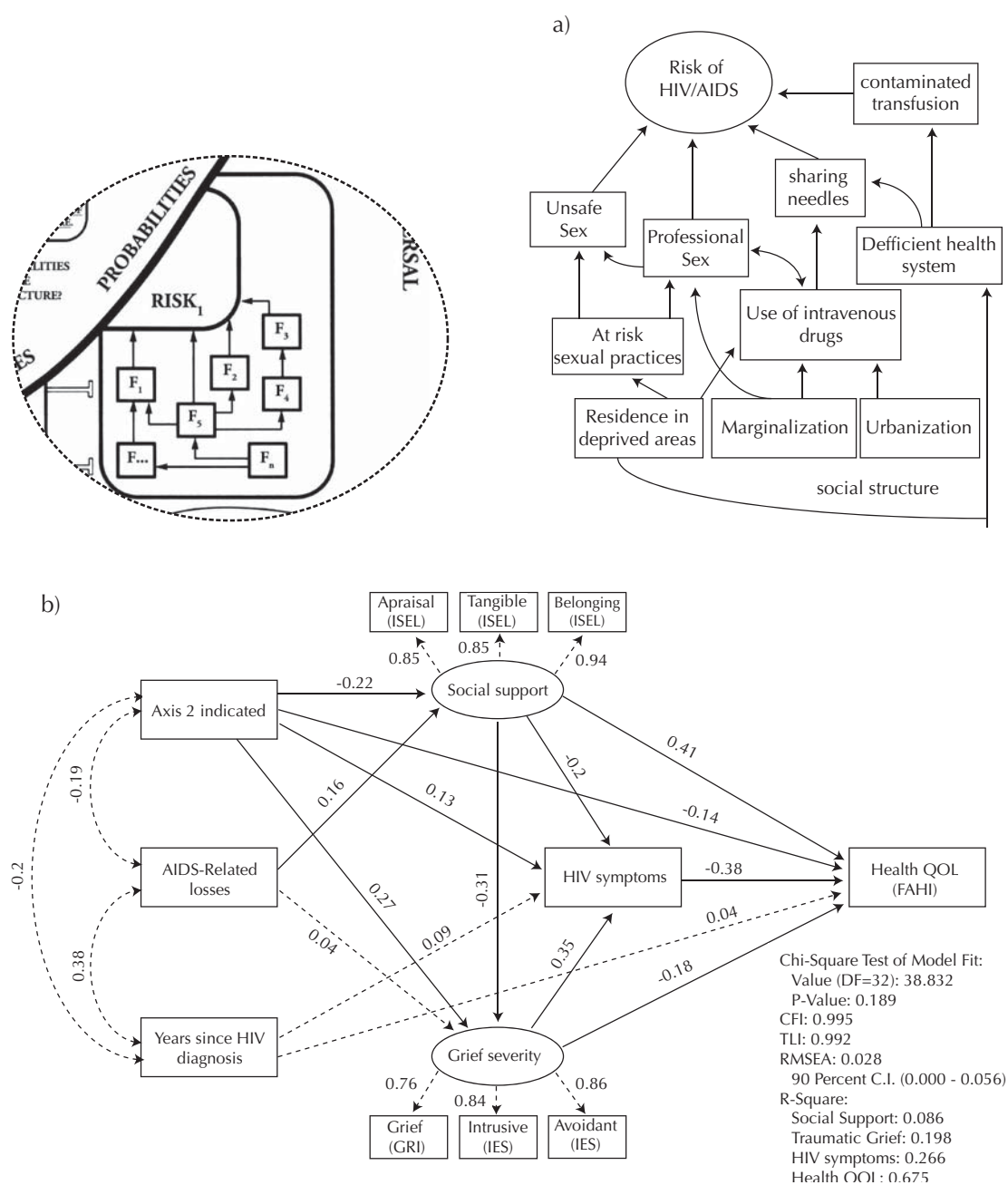
tissues, organisms; persons; families; neighborhoods; organizations; cities; nations; societies; environments. At any level of complexity, the DIS Complex can be examined from several angles, referred by different classes of model-objects, drawn according to various combinations of domains, instances and levels. Let us do it by decomposing the conceptual map presented in Figure 2. As an illustration of each class of these model-objects, I have collected different schemes used in the literature for representing HIV/AIDS and correlate issues.<sup>a</sup>

In the explanatory instance, a determinant-based approach (or a “strong deterministic model”) is made of highly structured causal metaphors operating in the domain of the singular. This heuristic instance depicts one of the facets (perhaps the most tangible one) of the model-object related to individual health: pathological processes manifested as a “case of disease”. The product of the explanatory determinant instance is a kind of finalistic, linear model-object that may be called a semblance-object, as proposed by Clavreul (1982).<sup>32</sup> In this sense, the term semblance is meant as a malleable clear-cut profile, paradoxically without the rigor and precision of computable objects. The paradox is that only semblance-objects can tolerate hard, rigid, causal metaphors of the clinical kind. A set of scientific disciplines established around this facet of the totalized object of health-disease-care has been considered in historical terms,<sup>39</sup> epistemological terms,<sup>68</sup> and semiological terms.<sup>17,18</sup>

A model-object of this class is presented in Figure 3. Note that this model is formed by discrete elements, linked with univocal, linear, monotonous, necessary relationships of causal determination, leading to the production of disease through deterministic causal pathways. Two examples of this model-object are also presented in Figure 3: a clinical-epidemiological modeling of AIDS etiology and a HIV/AIDS psychosocial causation model.<sup>63</sup> In the former, a singular specimen or given case of AIDS is modeled considering the mechanistic action of causes, contaminants, infectious forces, biological pathogens and individual susceptibility patterns. In the latter, a compound of life chances, psychosocial damages and high-risk behaviors is considered as necessary cause for the disease to occur clinically.

Relations of necessity (or causes) rule model-objects of this class. They fit simplification-prone frameworks better than complexity theoretical approaches. To model this segment of the health-disease-care complex, equivalent to drawing the causal model-object, analogical or abductive logic is more appropriate and it can be defined

<sup>a</sup> Almeida-Filho N. Modelos complexos de enfermedad: notas y esbozo de aplicación al HIV/SIDA. Salvador, Bahia: Instituto de Saúde Coletiva/Universidade Federal da Bahia; 2012 [cited 2013 Jul 16]. Available from: <http://www.scribd.com/doc/110651522/MODELOS-COMPLEXOS-DE-ENFERMEDAD-NOTAS-Y-ESBOZO-DE-APLICACION-AL-HIV-SIDA>



QOL: quality of life

**Figure 4.** Conditional risk as a deterministic model-object illustrated by (a) a social-epidemiological model (Almeida-Filho,<sup>a</sup> 2012) and (b) a Health QOL correlates of HIV/AIDS (Hansen et al,<sup>48</sup> 2009).

as analogical logic 1. The notion of abduction, derived from Peirce's philosophy, according to Samaja (1996),<sup>67</sup> is useful when "neither deduction nor induction could operate. In fact, deduction allows predictions only if the theory and the case are established, and induction allows only to verify (falsify or corroborate) these particular predictions."

Still in the explanatory pattern, one can find a different class of determinant model-objects, represented in

Figure 4. Operating in the epistemological domain of the universal, such a heuristic device is opposite to the clinical model-object built through causal reasoning in the domain of the singular. Rigorously speaking, they are concept-objects based upon a particular definition of chance modified from probability theory. Model-objects derived from this approach are supposedly grounded on probabilistic inductive logic, but actually they use a special kind of non-stochastic logic, which could be called quasi-inductive or inferential logic. For this

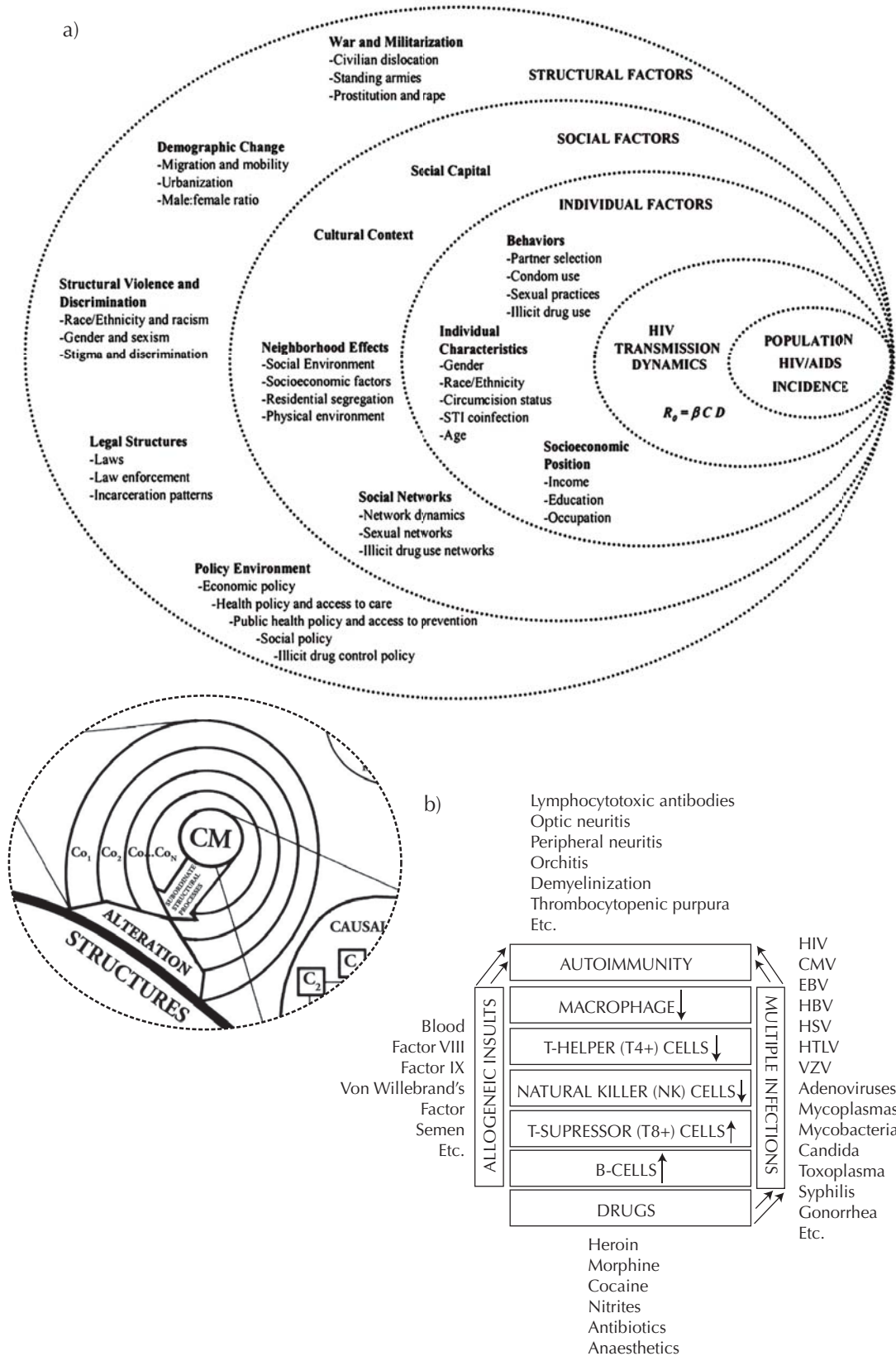


Figure 5. Structured model-object illustrated by (a) AIDS multidimensional context (Poundstone et al 2003) and (b) HIV pathogenesis structure (Bernstein 1992).

reason, such a class of model-objects may be considered as part of a “weak deterministic model”.

The facet of the health-disease-care integral reproduced therein constitutes a specific concept-object, designated for our purposes as Risk 1, which corresponds to the classical epidemiological notion of risk. Built upon what is left from statistical determination, after ruling out stochastic basic explanations for phenomena of disease occurrence, risk is not a true probability but rather it constitutes a frequency-based pseudo-probability.<sup>4,6</sup> Confirming its pragmatic character as a black-box heuristic device, finalistic, monotonous models of this kind produces a residue-object, resulting from the direct action or inter-action of risk factors.

In Figure 4, the conventional epidemiological perspective (the so-called epidemiology of risk factors) is illustrated by an epidemiological model of social determination of HIV/AIDS and a model of HIV/AIDS correlates of health-related quality of life.<sup>48</sup> In the figure,  $F_1, F_2, \dots$  to  $F_n$  are risk factors, defined within limits of probability of occurrence. Note in both cases that arrows do not represent necessary, absolute, univocal links but rather conditional probabilities, and that the elements that compose determinant systems of this kind are still discrete entities.

Let us move on to the structural instance, initially in the domain of the particular, where we can find a class of models that extract their heuristic capacity from topological objects. The structure is a matrix that consists precisely of invariants, the core is what remains as substrate after changing in the structure (and not of the structure). These are space-based metaphors drawn for referencing the action of particular invariant structures in the form of conditioners of processes. In Figure 5, in its general format,  $Co_1, Co_2, \dots$  to  $Co_n$  are conditioning elements, actually defining limits of variation. Such model-object is a matrix of constraints, or better, a structure that “constrains” the variation or change.

The product of these model-objects is generally states, which, for either singular or collective phenomena, could also be explained by deterministic models. This is represented in the basic drawing in Figure 5 as the CM (causal model) core, reference to disease states. Deterministic model-objects explain the occurrence of cases while structural model-objects refer to health-disease states. This class of stratified topological models has been dominated by classical deductive logic as the main source of internal consistency and external validation. What is most interesting is that this kind of model-object operates by configuring tracks for “change” made possible by structures, which in turn result themselves from “subordinate structural processes.”

This class of structural models of health-disease is more efficient for understanding conservation processes of a

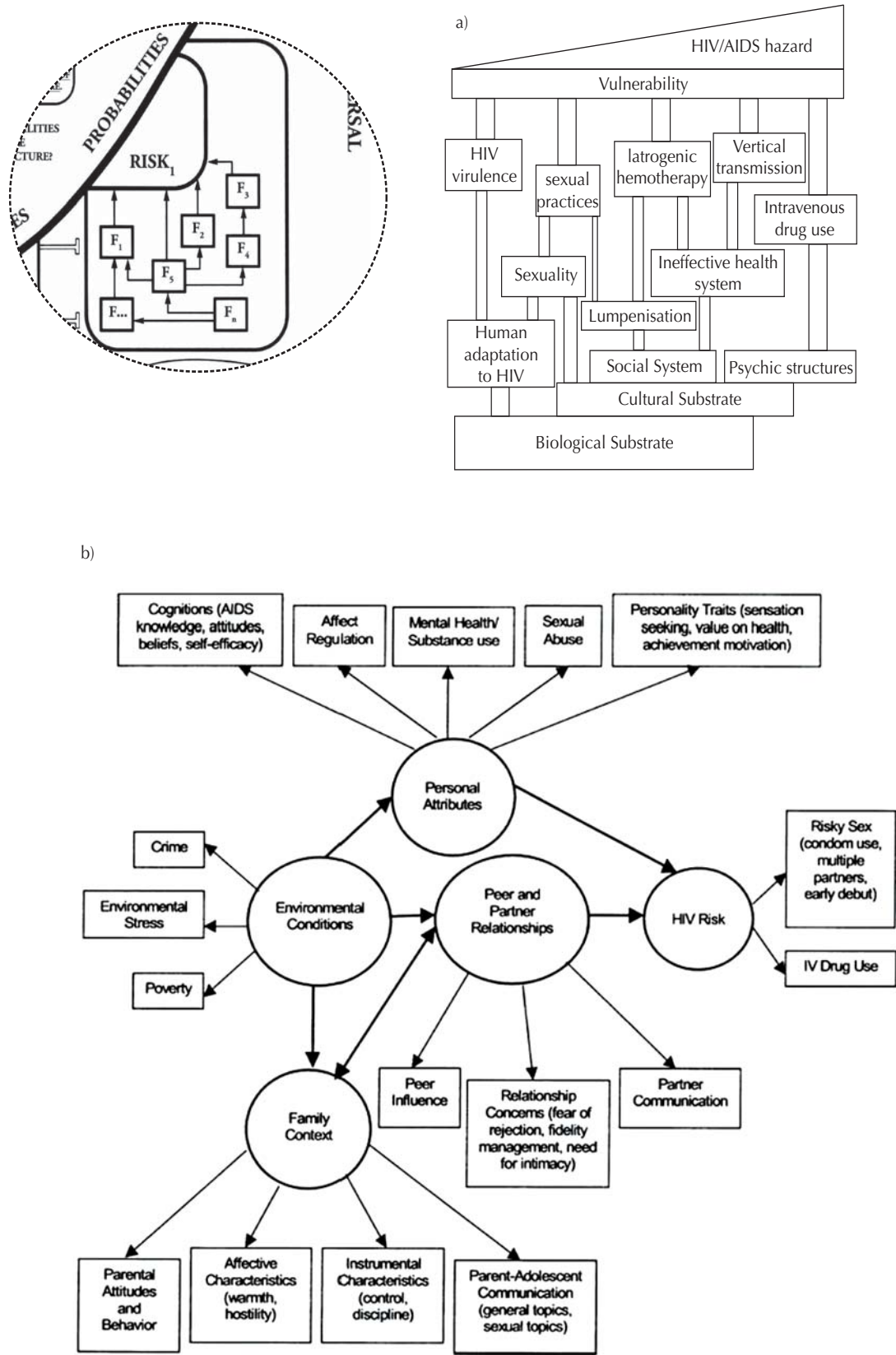
given “state of affairs”. Several partial and full examples of such model-objects can be found in biological and social sciences in a perspective that, generally designated as “structuralism”, stands in opposition to complexity theory.<sup>60</sup> The multidimensional contextual modeling of population HIV/AIDS incidence proposed by Poundstone et al,<sup>63</sup> Bowen’s multilevel ecological model of HIV risk context<sup>24</sup> and the classical Root-Bernstein’s HIV pathogenesis model<sup>65</sup> are examples of hierarchical structures that converge, respectively, to supra-individual and sub-individual model-states.

Covering one of the facets of health-disease-care integrals, now in the domain of universality, another class of structural model-objects is configured around matrices of possibilities. They are generally hierarchical matrix models, converging to fixed logical forms that indicate possibilities of the structure. The potentiality (or virtuality) of this heuristic device derives from the operation of a logic framework that generates possibilities for the occurrence of events “deduced” from the compilation of information and integration of knowledge produced by application of related models of determinant explanation. Model-objects derived from this approach actually use a special kind of deductive logic, which I propose to call “possibilistic” or quasi-deductive logic. Formally, logical maps of the format shown in Figure 6 are congruent to such structured model-objects. In its general format,  $Po_1, Po_2, \dots$  to  $Po_n$  are conditioning elements, defining limits of possibilities.

In the health field, several disciplinary applied subfields - for example, occupational health and health surveillance - ground their theoretical practice in model-objects of this kind. Outcomes of such model-objects may be referred to as Risk 2, in which the notion of risk is much closer to the common-sense concept of risk-danger as a potential, hidden threat. Indeed, model-objects of health-disease of this kind are more efficient for describing structures that are supporting a given set of interconnected processes. In Figure 6, model-objects of this class (possibilistic structural risk) may be illustrated by two different conceptual maps of Risk/Hazard/Vulnerability related to HIV/AIDS.<sup>36</sup>

In the instance of dynamic systems, now in the domain of the particular, heuristic devices of this class may be defined by sensitivity to their own systemic movement. Such a kind of model-object is non-finalistic and non-linear, incorporating better possibilities for dealing with ruptures, ambiguities, inconsistencies and contingencies. As shown in Figure 7, in its basic general format,  $Dn_1, Dn_2, \dots$  to  $Dn_n$  are dynamic elements, indicating nodes of a complex network. Such artifacts tend to be cyclical, iterative, interconnected. To the limit, they can have a hyper-hierarchical fractal structure (in





**Figure 6.** Structural risk as a possibilistic model-object illustrated by (a) HIV/AIDS Hazard/Vulnerability model (Almeida-Filho<sup>a</sup> 2012) and (b) Risk Vulnerability model (Donenberg & Pao,<sup>36</sup> 2005).

the sense that each Dn can hold lower-order processes organized as a network with fractal structure similar to the general network). As they are configured, products of those model-objects are networks of processes that produce networks of processes. The predominant logic in these model-objects is concerned with general laws of movement-variation; it may be called a type 1 dialectic.

The facet that corresponds to this instance/domain of the integral-object health-disease takes the general form of “health-disease-care dynamic systems,” generated by iterative and interconnected systemic models. The potentiality of this approach to build systemic models applicable to health promotion and disease prevention is enormous. With this aim, one needs to identify hubs, “hot spots” or critical points where interventions of low-grade power shall provoke potentiated synergistic effects with higher potential for transformation. In Figure 7, disease processes are represented by a systemic model-object, along with two examples of this kind of model: a system network of determination of HIV/AIDS and a complex model information and help seeking behavior for AIDS patients.<sup>73</sup>

As seen in Figure 2, there are facets of the health-disease-care integral that have not been targeted by early attempts at formalizing health-disease model-objects. Models composed by non-discrete elements, with blurred boundaries between elements and unclear limits between the system itself and outer contexts are called fuzzy systems, form a class of model-objects defined by “prototypical properties”, degree of polysemy and “mutant properties” of composing elements.<sup>57,66</sup> Located in the transition from systemic to synthetic instances, prototype models are open to rich possibilities of dealing with traits-signs-types of immaterial occurrence, either linguistic or conceptual. In this framework, signs are semiologic objects that indicate (other) objects of a similar class, traits are signs indexing a property of the model-object, types imply pertinence to categories, and prototypes are types with degrees of pertinence.

In the domain of the general, both approaches comprise unstructured objects. For decades, such model-objects hindered any attempts at formalization. More consistent and rigorous criteria for logical treatment of these new objects only recently have been established.<sup>66</sup> As far as logical consistency and validity are concerned, both approaches need a different kind of transitive logic: from possibilities or degrees of pertinence to “boundary ramps” and to a *degradé* of prototypical limits. Fuzzy set logic have been developed as possible sources for logical criteria to validate such models. I propose to consider in the scheme transitive logics of this kind as part of a type 2 dialectic.

Finally, let us examine the synthetic instance of the health-disease-care integral model of Figure 2. In

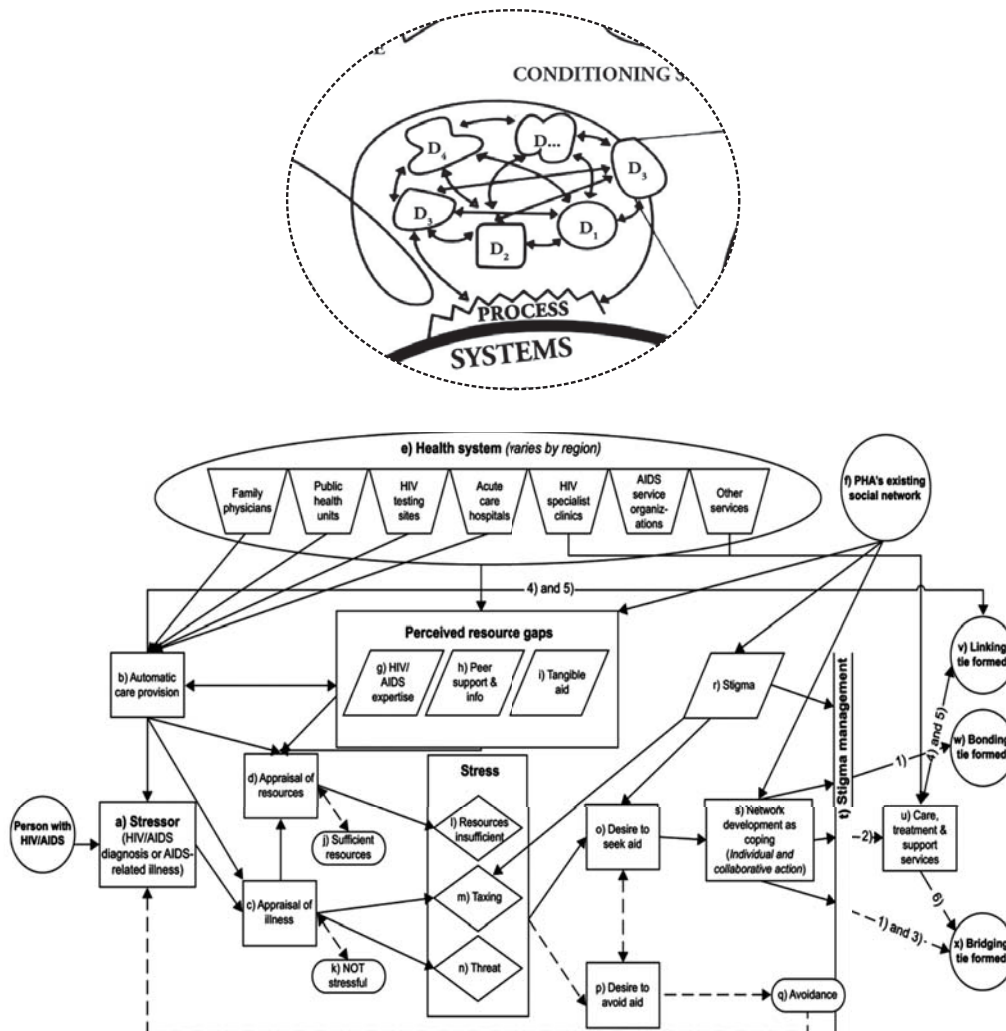
this instance, emerging model-objects may be figured directly by images or visual metaphors, ruled by a general kind of transformation, which I propose to call anamorphosis 1, or by a particular kind of transformation, which may be called anamorphosis 2. This synthetic instance allows to incorporate, into a unified model-object, different classes of reference: a) propositional models, which assume logical forms that specify elements, properties and relationships of comprehensive structures; b) iconic models, schemata and graphic and visual forms that, in varied ways, convey an ideological imagery of health-disease; c) metaphorical models, which result from the ability of a propositional or iconic model to pass from one domain to another; d) metonymic models, which result from displacements, dislocations and substitutions, again across domains and planes of occurrence of health-illness-care phenomena.

In both domains of generalness and particularity, the rationale of these model-objects is justified by a class of analogy distinct from abduction, which I propose to name as analogical logic of type 2. This logic is mostly metonymic, based on hermeneutical processes of double contextualization, that is, simultaneous reference to theory-engendered objects and to objects that encompass “real world” contingencies.

In sum, levels, domains, logics, models, products, objects, forms are condensed to produce synthetic complex model-objects, such as the example of a prototypical model – object illustrated by a semiological model of social perception of HIV/AIDS<sup>17</sup> shown in Figure 8. These are polisemic, multifaceted, pluralistic model-objects, simultaneously ontological and heuristic, capable of transiting across (or being traversed by) different domains or levels. In this apparently chaotic modeling process, health can be defined as a configuration, one of these many synthetic forms that, like a storm, make sense only as an integral. Take HIV/AIDS as an example: AIDS is more than ‘disease’ in the clinical sense, more than ‘injury’ in the histological meaning, more than ‘risk 1’ in the epidemiological sense, more than ‘risk 2’ under the health environmental sense, more than being a ‘process’ in the ecological sense, beyond a ‘prototype’, in the semiological sense, and not reducible to a form’, component of the social imaginary. AIDS is all of this, plus the transformation of each of these facets, namely, its historicity.

## CONCLUDING REMARKS

In this paper, I have proposed a conceptual background for a unified theory of health, based on two constructs: the DIS Complex, as a reference for disease-states, and ‘health-disease-care integrals’, reference model for health-states. Along this line, health-disease-care should be taken as more than a composite reference



**Figure 7.** Disease processes as a systemic model-object illustrated by (a) a network model of HIV/AIDS determination (Almeida-Filho,<sup>a</sup> 2012) and (b) a complex model of HIV/AIDS information/help-seeking behavior (Veinot,<sup>73</sup> 2010).

object, but rather as one of those synthetic forms that, since they refer to the concrete world, are built by reference to phenomena, individual and collective, targeted by the so-called health sciences. In this perspective, a broad statement can be issued:

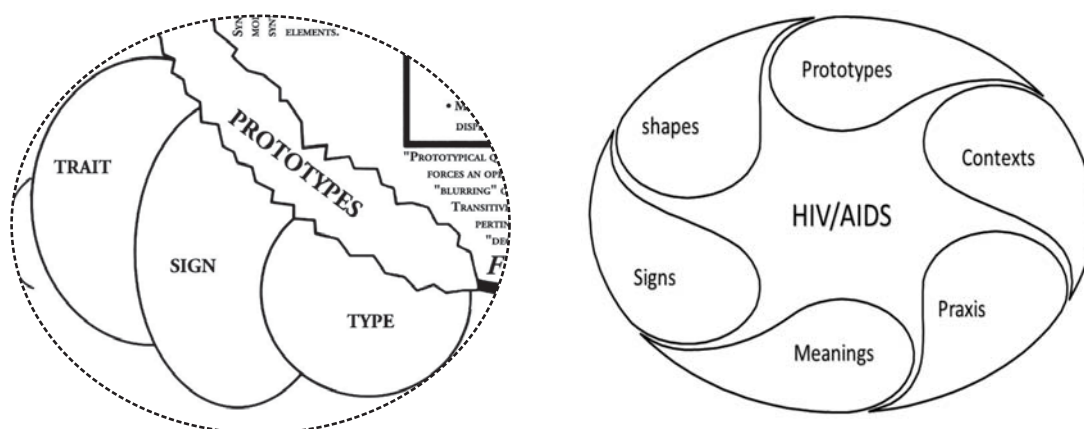
Health is a unified model-object formed by the synthetic ensemble of modes of being, emerging from the articulation of all patterns, comprising domains, levels and logics, as well as models, products and objects related (and drawn by reference) to phenomena of life, function, performance, production, suffering, affliction, illness, care, healing and death in human subjects, groups and social institutions.

Rigorously speaking, this proposition is not a discrete conceptual definition since it basically outlines composition and localization patterns of the complex object health, without the heuristic power of differentiating

this set of phenomena from other related phenostructured objects. Modeling complexity ends up producing synthetic forms that, overdetermined by different species of determinants, transcend the formal properties of discrete model-objects.<sup>14,45,47,72</sup> In this sense, integrals are meta-synthetic reference objects, that is, they express more than a “synthesis of multiple determinations”. The key point of this paper’s argument is that constructs of this kind form a new family of scientific objects, i.e., model-objects defined not by their components, functional principles, and dimensions but rather by their totality and general principles, over all planes of emergence.

Indeed, health-disease processes and related phenomena imply a peculiar class of synthetic model-objects.

As such, they are not amenable to the production of knowledge by way of fragmentation (hence, objects adverse to analytical processes) but by way of synthesis and complex modeling.<sup>31,47</sup> They end



**Figure 8.** Disease as a prototypical model-object illustrated by a semiological model of social perception of HIV/AIDS (Bibeau,<sup>17</sup> 1992).

up being polysemic-polymorphic model-objects, simultaneously ontological and heuristic, construed for (and by) reference to the phenomenological dimensions of health research. Model-objects of this kind tend towards a higher degree of abstraction to become meta-synthetic objects, construed for (and by) reference to the reality produced by the so-called health sciences.

The properties of holistic plurality of health-disease-care integrals and similar heuristic objects have been explored poorly in present-day scientific practice. To reduce the complexity of the health-disease object to unidimensional concepts such as risk, hazard, disease, deficiency, lesion, and other ontological devices of this kind, despite the undeniable effective applications for technology building and practical interventions, implies missing the epistemological core that define it as an object of knowledge.

In sum, the fundamental epistemological question in modeling health-disease for approaching the

multifaceted totality of 'health' as a complex object consists precisely of identifying structuring interfaces. In this regard, complex model-objects in health may be prototypical for the desired integration between social sciences (e.g., with the macro-social processes represented as composition of elements at the basis of the model), logic and semantics (to justify links among factors in sub-models) and public health or clinical sciences (responsible for modeling health outcomes). Therefore, for further developments, we hope researchers and scholars to start conceptualizing "health" in a way that respects its integrality and plurality, in the rich and complex reality of the field of human health.

A forthcoming article of this series is an effort, yet partial and provisional, to formulate a "special theory" for this class of objects, which are reference to non-health complex phenomena commonly named as disease, illness or sickness, combining the notions of over-determination, multi-levelness and cross-dimensionality.



## REFERENCES

- Albrecht G, Freeman S, Higginbotham N. Complexity and human health: the case for a transdisciplinary paradigm. *Cult Med Psychiatry*. 1998;22(1):55-92.
- Almeida-Filho N. The paradigm of complexity: applications in the field of public health. In: Advisory Committee on Health Research. A research policy agenda for science and technology to support global health development. Geneva: World Health Organization; 1997. p.1-15.
- Almeida-Filho N. Health: the complex object. In: Sayers B, organizer. Health assessment: complexity, trends and opportunities. Geneva: WHO Global Advisory Committee for Health Research; 1999. p.12-25.
- Almeida-Filho N. *A ciência da saúde*. São Paulo: Hucitec; 2000.
- Almeida-Filho N. Qual o sentido do termo saúde? [editorial]. *Cad Saude Publica*. 2000;16(2):300-1. DOI:10.1590/S0102-311X2000000200001
- Almeida-Filho N. La ciencia tímida: ensayos de deconstrucción de la epidemiología. Buenos Aires: Lugar Editorial; 2000.
- Almeida-Filho N. O conceito de saúde: ponto-cego da epidemiologia? *Rev Bras Epidemiol*. 2000;3(1-3):4-20. DOI:10.1590/S1415-790X2000000100002
- Almeida-Filho N. For a general theory of health: preliminary anthropological and epistemological notes. *Cad Saude Publica*. 2001;17(4):753-70. DOI:10.1590/S0102-311X2001000400002
- Almeida-Filho N, Jucá V. Saúde como ausência de doença: crítica à teoria funcionalista de Christopher Boorse. *Cienc Saude Coletiva*. 2002;7(4):879- 89. DOI:10.1590/S1413-81232002000400019
- Almeida-Filho N, Lessa I, Magalhães L, Araújo MJ, Aquino E, James SA, et al. Social inequality and depressive disorders in Bahia, Brazil: interactions of gender, ethnicity, and social class. *Soc Sci Med*. 2004;59(7):1339-53. DOI:10.1016/j.socscimed.2003.11.037
- Almeida-Filho N. A saúde e o paradigma da complexidade. *Cad IHU Unisinos*. 2006;4(15):1-45.
- Almeida-Filho N. Complejidad y transdisciplinariedad en el campo de la Salud Colectiva: evaluación de conceptos y aplicaciones. *Salud Colectiva*. 2006;2(2):123-46.
- Almeida-Filho N, Coutinho D. Causalidade, contingência, complexidade: o futuro do conceito de risco. *Physis (Rio J)*. 2007;17(1):95-137. DOI:10.1590/S0103-73312007000100007
- Almeida-Filho N, Andrade RF. Holopatogênese: esboço de uma teoria geral de saúde-enfermedad como base para la promoción de la salud. In: Czeresnia D, Freitas CM, organizadores. Promoción de la salud: conceptos, reflexiones, tendencias. Buenos Aires: Editorial Lugar; 2008. p.113-34.
- Almeida-Filho N. *O que é Saúde?* Rio de Janeiro: Editora Fiocruz; 2011.
- Barondess JA. Disease and illness: a crucial distinction. *Am J Med*. 1979;66(3):375-6.
- Bibeau G, Murbach R, editors. L'univers du SIDA. Québec: Université Laval Press; 1992.
- Bibeau G, Corin E. Culturaliser l'épidémiologie psychiatrique. Les systèmes de signes, de sens et d'action en santé mentale. In: Charest P, Trudel F, Breton Y, editors. Marc-Adélaire Tremblay ou la construction de l'anthropologie québécoise. Québec: Presses de l'Université Laval; 1994. p.105-148.
- Bhaskar R. *A realist theory of science*. London: Routledge; 2008.
- Boorse C. Health as a theoretical concept. *Philos Sci*. 1977;44(4):542-73.
- Boorse C. Concepts of health. In: Van De Veer D, Regan T, editors. Health care ethics: an introduction. Philadelphia: Temple University Press; 1987. p.359-91.
- Boorse C. A rebuttal on health. In: Humber J, Almeder R, editors. *What is disease?* Tutana: Humana Press; 1997. p.1-134.
- Boulding K. General systems theory: the skeleton of science. *Manag Sci*. 1956;2(3):197-208.
- Bowen E. A multilevel ecological model of HIV risk context for low-income, unstably housed drug users in urban areas of the United States. In: 19th International AIDS Conference; 2012; Washington, DC. [Abstract n°.THPE515].
- Breslow L, Belloc NB. Relationship of physical health status and health practices. *Prev Med*. 1972;1(3):409-21.
- Bunge M. Teoría y realidad. Barcelona: Ariel; 1972.
- Callahan D. The WHO definition of 'health'. *Stud Hastings Cent*. 1973;1(3):77-88.
- Campos T. Health as a basic human need: would this be enough? *J Law Med Ethics*. 2012;40(2):251-67. DOI:10.1111/j.1748-720X.2012.00662.x
- Canguilhem G. Nouvelles réflexions sur le normal et le pathologique. Paris: P.U.F; 1966.
- Canguilhem G. La santé: concept vulgaire et question philosophique. Toulouse: Sables; 1990.
- Castiel LD, Vasconcellos-Silva PR. Don Quixotech in New Laputa. *J Epidemiol Community Health*. 2007;61(5):388.
- Clavreuil J. *Ordem médica: poder e impotência do discurso médico*. São Paulo: Brasiliense; 1983.
- Coelho MTAD, Almeida-Filho N. Conceitos de saúde em discursos contemporâneos de referência científica. *Historia Cienc Saude Manguinhos*. 2002;9(2):315-33. DOI:10.1590/S0104-59702002000200005
- Corin E. The social and cultural matrix of health and disease. In: Evans RG, Barer ML, Marmor TR, editors. Why are some people healthy and others not? The determinants of health of populations. Hawthorn: Aldine de Gruyter; 1994. p.93-132.

35. Delattre P. *Teoria dos sistemas e epistemologia*. Lisboa: A Regra do Jogo; 1981.
36. Donenberg GR, Pao M. Youths and HIV/AIDS: psychiatry's role in a changing epidemic. *J Am Acad Child Adolesc Psychiatry*. 2005;44(8):728-47. DOI:10.1097/01.chi.0000166381.68392.02
37. Dubos RJ. Health and disease. *JAMA*. 1960;174(5):505-7. DOI:10.1001/jama.1960.63030050003011a
38. Edmonds B. What is complexity? In: Heylighen F, Aerts D, editors. *The evolution of complexity*. Dordrecht: Kluwer; 1996. p.20-6.
39. Engelhardt Jr HT. Health and disease: philosophical perspectives. In: Reich WT, editor. *Encyclopedia of bioethics*. Revised edition. London: Simon & Schuster and Prentice Hall International; 1995. p.1101-6.
40. Fedoryka K. Health as a normative concept: towards a new conceptual framework. *J Med Philos*. 1997;22(2):143-60.
41. Fettke P, Loos P. Ontological evaluation of reference models using the Bunge-Wand-Weber-model. In: Ross JW, editor. *Proceedings of the 9th Americas Conference on Information Systems*. Tampa: Association for Information Systems; 2003. p.2944-55.
42. Gadamer HG. *The enigma of health*. Stanford: Stanford University Press; 1996.
43. Gammelgaard A. Evolutionary biology and the concept of disease. *Med Health Care Philos*. 2000;3(2):109-16.
44. Gatrell AC. Complexity theory and geographies of health: a critical assessment. *Soc Sci Med*. 2005;60(12):2661-71. DOI:10.1016/j.socscimed.2004.11.002
45. Godfrey-Smith P. *Theory and reality: an introduction to the philosophy of science*. Chicago: University of Chicago Press; 2003.
46. Goenner HFM. On the history of Unified Field Theories. *Living Rev Relativity*. 2004;7(2):5-153. DOI:10.12942/lrr-2004-2
47. Hammond D. *The science of synthesis: exploring the social implications of General Systems Theory*. Boulder: University of Colorado Press; 2003.
48. Hansen NB, Vaughan EL, Cavanaugh CE, Connell CM, Sikkema KJ. Health-related quality of life in bereaved HIV-positive adults: relationships between HIV symptoms, grief, social support, and Axis II indication. *Health Psychol*. 2009;28(2):249-57. DOI:10.1037/a0013168
49. Huber M, Knottnerus JA, Green L, Horst H, Jadad AR, Kromhout D, et al. How should we define health? *BMJ*. 2011;343:d4163. DOI:10.1136/bmj.d4163
50. Karnopp DC, Rosenberg RC. *Systems dynamics: a unified approach*. New York: Wiley-Interscience; 1975.
51. Kleinman A, Eisenberg L, Good B. Culture, illness, and care: clinical lessons from anthropologic and cross-cultural research. *Ann Intern Med*. 1978;88(2):251-8. DOI:10.7326/0003-4819-88-2-251
52. Kleinman A. Concepts and a model for the comparison of medical systems as cultural systems. In: Currer C, Stacey M, editors. *Concepts of health, illness and disease: a comparative perspective*. Oxford: Berg Publishers; 1986. p.29-47.
53. Krieger N, Zierler S. What explains the public's health? A call for epidemiologic theory. *Epidemiology*. 1996;7(1):107-9.
54. Larson JS. The conceptualization of health. *Med Care Res Rev*. 1999;56(2):123-36. DOI:10.1177/107755879905600201
55. Levine S. The meanings of health, illness and quality of life. In: Guggenmoos-Holzmann I, Bloomfield K, Brenner H, Flick U, editors. *Quality of life and health: concepts, methods and applications*. Berlin: Blackwell Wissenschafts-Verlag; 1995. p.7-14.
56. Mezzich J, Almeida-Filho N. Epidemiology and diagnostic systems in psychiatry. *Acta Psychiatrica Scand*. 1994;90(Suppl s385):61-5. DOI:10.1111/j.1600-0447.1994.tb05915.
57. Minsky M. *The society of mind*. New York: Simon & Schuster; 1988.
58. Morin E. On the definition of complexity. In: Aida E, editor. *The science and praxis of complexity*. Tokyo: United Nations University; 1984. p.62-8.
59. Morin E. *Introduction à la pensée complexe*. Paris: Editions Sociales Françaises; 1990.
60. Nietzsche FW. *The gay science*. Cambridge: Cambridge University Press; 2001.
61. Nordenfelt L. Concepts of health and their consequences for health care. *Theor Med*. 1993;14(4):277-85.
62. Poundstone KE, Strathdee SA, Celentano DD. The social epidemiology of human immunodeficiency virus/acquired immunodeficiency syndrome. *Epidemiol Rev*. 2004;26(1):22-35. DOI:10.1093/epirev/mxh005
63. Richardson KA, Midgley G. Systems theory and complexity: Part 4 - The evolution of systems thinking. *Emerg Complex Organ*. 2007;9(1-2):163-79.
64. Root-Bernstein RS. HIV and immunosuppressive cofactors in AIDS. *J Immunol Immunopharmacol*. 1992 [cited 2013 Jul 16];12(4). Available from: <http://www.virusmyth.com/aids/hiv/rrbeos.htm>
65. Sadegh-Zadeh K. Fuzzy health, illness, and disease. *J Med Philos*. 2000;25(5):605-38. DOI:10.1076/0360-5310(200010)25:5;1-W;FT605
66. Samaja J. *Epistemología y metodología*. Buenos Aires: Eudeba; 1996.
67. Samaja J. *Epistemología de la salud*. Buenos Aires: Lugar Editorial; 2004.
68. Saracci R. The World Health Organization needs to reconsider its definition of health. *BMJ*. 1997;314(7091):1409-10. DOI:10.1136/bmj.314.7091.1409
69. Schramm FR, Castiel LD. Processo saúde/doença e complexidade em epidemiologia. *Cad Saude Publica*. 1992;8(4):379-90. DOI:10.1590/S0102-311X1992000400004

70. Stempsey WE. A pathological view of disease. *Theor Med Bioeth.* 2000;21(4):321-30.
71. Strogatz SH. *Sync: the emerging science of spontaneous order.* New York: Theia Books; 2003.
72. Veinot T. A multilevel model of HIV/AIDS information/help network development. *J Doc.* 2010;66(6):875-905. DOI:10.1108/00220411011087850
73. Von Bertalanffy L. General systems theory: a critical review. *Gen Syst.* 1962;7:1-20.
74. Weed DL. Beyond black box epidemiology. *Am J Public Health.* 1998;88(1):12-4.
75. Wulff HR. The concept of disease: from Newton back to Aristotle. *Lancet.* 1999;354(Suppl):SIV50.
76. Young A. The anthropologies of illness and sickness. *Ann Rev Anthropol.* 1982;11; 257-85.

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