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RESEARCH ARTICLE

Will Public Health be Able to Meet the New Challenges of a Changing World?

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“We no longer belong to the family of tragic heroes who subsequently found out that they had prepared their own fates. We know it beforehand”

Niklas Luhmann

ABSTRACT

The organisation of society into social systems led, from the nineteenth century onwards, to the differentiation of medicine. Its object has been diseases, with the sub-systems of healthcare, responsible for diagnosis and treatment, and public health, responsible for communicating the truths of medical science to the population with the aim of preventing and treating diseases. This organisation, which remains effective, is currently facing two problems:

- Its possible extension of its scope to include health as understood by international organisations, in order to meet the challenges posed by the rapid transformation of the planet: global warming, overpopulation, ageing, poverty, etc.
- The ability to make this advice effective at a time when there is no longer an entity that can generate the confidence needed to apply its recommendations.

To overcome the silos that have prevented the changes we are undergoing today, it will be necessary to organise collaborations that the revolution brought about by Artificial Intelligence (AI) may be able to facilitate.

Introduction

Health has been traditionally considered as a balance between different forces animating the human body: For the Greeks four humours (1), for the Indians three Doshas (2), yin and yang for the Chinese (3). These holistic representations made it possible to conceive of health as a compliance to a divine order and, later, to a natural order, whose transgression led to disasters and diseases. The influence of heredity and the environment were already mentioned (4). For a long time, its evidence left little room to question their validity. Prevention took precedence over care, the objective of which could even be considered as going against the divine order (sacrilege) or the laws of nature. This vision has not completely disappeared. If it does not usually reach the certainty of some of my Catholic patients of AIDS as divine punishment for prohibited sexual practices, a moral causality is more or less explicitly considered by everyone at the time of the discovery of serious illnesses.

This vision has undergone a radical transformation in the West with the development of science as a social system responsible for seeking truth through an empirical approach. It divides the complex into simple, « obvious » elements allowing their mathematical analysis from which a synthesis leads to practical decisions justified by the (now Bayesian) observation of their results (5). If health can be defined by the OMS as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. “, like wisdom, happiness or beauty, it is seldom recognized as object of science. While they were the goals of a good life, they cannot be condensed for practical use to meet the new goals of society. If politics, law and economics were the first concerned, modern medicine, born in the nineteenth century, followed this path. It is an example of the development of social systems, products and actors of the complexification of society. It is concerned with diseases.

In order to understand the current challenges facing public health, I felt it necessary to address medicine through science and communication, beginning with a description of the healthcare system. Given the complexity of the subject, I do not claim to be exhaustive. I present only a few lines of thought. I will often rely on Niklas Luhmann (6,7,8). In his constructivist theory of society, that helped me a lot to understand and change my practice, every decision limits the possible choices of further decisions. Their succession makes probable the occurrence of future events which, in isolation, would have remained highly improbable. It prefigures, in the domain of social sciences, the Order of Things

Assembly theory of Leroy Cronin which, today, explains the birth of life (9).

Healthcare medicine as a social system

Every social system answers to a functional problem by selecting a “form” that gives it meaning. In the case of the healthcare system, I make the assumption that it is diseases. From the beginning of the nineteenth century, their objectification has been its main subject. Anatomic pathology was one of its first specialities (10).

The differentiation (autopoiesis) of a social system goes through its communication as a selection followed by a transmission and an understanding (11). The operation of naming a disease (making a diagnosis) applies the self-reference of a system that is operationally closed, but communicatively open. Healthcare communication is directed towards healthcare workers during their studies and subsequent continuing education, but also, through non dedicated media towards other social systems and the general population. Once internalized, this selection becomes natural for these first-level observers (in their daily lives). Subsequently, it is unconsciously reintroduced into any reflection on the subject. The rest of the world, excluded, remains in the background.

The grouping together of a set of signs defines what diseases are. These algorithms enable diagnosis to be made, leading to treatment and the study of causes that should be prevented. Their practical application explains the blindness of the system to what is not a disease, including individuals and, among them, health professionals. In the absence of total or partial congruence with these algorithms, the patient's discourse becomes “noise” which disturbs the doctor's interpretation (12). If its irritations become sufficiently acute to be taken into account, medical science will give it meaning by associating it with a disease that is already known or by creating (naming) a new disease: AIDS was recognised ten years after the epidemic began in the USA and more than thirty years after it emerged in Africa (13). Hallucinogens, illegal since the 1970s, are coming back as a “trend” to improve current psychiatric treatments (14).

Each system presupposes organisations that realize (act) what is meant. The health care system, which was initially organised around health officers and hospices, has differentiated, with a stratification ranging from teaching hospitals, which are partners in the scientific system to produce medical truth, and distribute it to specialists and general practitioners

who receive the initial requests for care and apply their algorithms. The basic functional unit is the medical consultation. The need to cope with the rapid increase in medical knowledge has led the healthcare system to segment itself into sub-systems with a restricted "form": specialities which focus on groups of diseases (organs) to improve its productivity (cardiology, pneumology, oncology, hematology ,...). Your pulmonologist will not listen to your back pain if it is not related to a metastasis of your lung cancer. This restrictive approach could be quickly overturned by the use of Artificial Intelligence (AI). By organising medical knowledge with Bayesian weights, as it is declined for example in the software "up to date", it will offer much safer decision-making algorithms than those proposed by doctors with their limited and often obsolete knowledge. AI has already demonstrated its shape recognition performance in radiology and anatomic pathology. It will also be able to advance clinical knowledge that has been left-out for several decades. Productivity (quality, costs) will be considerably improved but it remains to be defined, depending on the nature of the developers (states, GAFA, medical associations, universities, etc.) who will have access to it and who is going to profit. Whatever happens, the medical profession will be transformed once and for all (15).

Healthcare professionals, like the population as a whole, have accepted this organisation. It prohibits any questioning of its selection of diagnosis and treatment as topics, to the detriment of prevention and individual situations. They are not taught. This success of healthcare communication is not linked to the system's actual ability to cure diseases, but to the shared belief between health professionals and the general public in its possible efficacy. In the eighties, at the onset of the AIDS epidemic, media coverage of a short-term death sentence for HIV-positive people temporarily opened the door to listening to their non-medical problems and proposing solutions outside the healthcare system until the arrival of tritherapies. At the same time, a 10-year mortality rate of 92% for lung cancer was accepted by patients and healthcare (16). The ability of oncologists to remain blinded to this inefficiency was linked to the unspoken nature of death and to their faith in a better future, which has now come partially true (50% cured today).

With its success, demand outstripping supply, the healthcare offer has been able to remain blind to the possibility of improving its performance by reaching the entire population, contributing to the inequality of access to healthcare services observed even in European welfare states. It has consequences:

- In terms of healthcare provision, it reinforced a system that excludes the individual complexity of each patient. Like its social impact, an evaluation of patients' compliance is irrelevant to the prescriber (50% of chronically ill patients do not follow their treatment) (17). These blind spots have an incidence on the content and duration of consultations. In 2017, in 18 countries representing 50% of the world population, the length of GP consultations was less than 5 minutes (18). This lack of relational time can "fortunately" be replaced by new prescriptions.

- As far as public health is concerned, this lack of interest in healthcare provision means that specific programmes need to be set up to assess its impact on society. They must be designed and financed by other systems: In 2011, the French centres of reference abandoned the recording of the number of hepatitis cases they treated for the French public health network once the period during which they were supposed to had come to an end.

- For users, it encouraged a passive consumerist approach at the expense of active preventive care for their health or behaviour changes, by creating the illusion that technical progress is capable of finding a cure to all diseases. It tells users that they are right if they have the time to wait long enough, if they are rich or, until now, if they live in a welfare country. The Times They are a-Changing: Today France does not reimburse new treatments for sleep disorders and migraines. Who will afford gene therapy?

- In many countries, the State, offering a space where republican equality could be concretely achieved, maintains its legitimacy in the face of challenges to its political dominance. The collapse of the NHS has become a new source of political communication (19). There is no real "World" politics. Unequal access to the covid-19 vaccine is a good example. The exceptional universal access to AIDS treatment can be linked to the fear of rich countries of the maintenance and extension of the epidemic.

- For the economy, it offered outlets for production that would generate guaranteed profits, jobs, growth and revenue for the industry and the political organization. The particular model of combining state funding of insurance with ultra-liberal industrial production of tools and medicines whose development and evaluation are almost exclusively entrusted to the state, creates a

situation where it is clear that ideal market conditions have not been achieved and that 'conflicts of interest' are inevitable: The pharmaceutical industry is one of the most profitable.

Differences in the selection inherent of each system lead to different interpretations of the same event: An accident resulting in a muscular-ligamentous trauma occurring during a journey to work calls into question the knowledge of medical science through medical professionals. Although osteo-articular problems are the leading cause of disability worldwide, they have progressed little over the last thirty years. The fact that these diseases first impact social groups with the lowest incomes emphasizes the relation with economics and politics. Depending on the quality of social security coverage, sick leave and the cost of possible treatment may remain entirely the responsibility of the injured party or be paid by additional insurance or even by the employer, involving different subsystems: economics (employment, insurance, taxes), politics (definition of social coverage) and the law (the employer will be able to challenge his involvement).

These examples demonstrate the lack of congruence between different social systems whose communications are restricted to their structural couplings, a preliminary understanding before addressing public health.

Public health as a subsystem of medicine different from healthcare

PUBLIC HEALTH OBSERVES DISEASES NOT HEALTH

Public health's name suggests that its dealing with health would not agree with my hypothesis of its association with healthcare to form medicine. For the WHO "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (20). To meet these objectives, physical, mental and social well-being must be defined. What can be found in common between the "good" health of children, adults and elderly apart from the absence of diseases? If there is an "essence" of health, then the answer should be found by a second order observation of what public health observes, its communication and its actions.

○ Almost every one of the 360 indicators WHO applies to explore the world of health are related to prevention, detection and treatment of diseases (21). Worlds like wealth, income, earning are not found, education is always related to disease prevention. What is even more striking is that well-being and happiness are absent. It is the same for quality of life.

○ The main problem facing public health definition comes from the oldest and most frequently used indicator: death rate. It is easy to observe that not all deaths are of concern to public health, although it counts them all. Deaths caused by a tornado, a flood or an earthquake are counted, but do not give rise to medical research apart from the treatment of the injuries they have caused. The number of publications listed in August 2023 by the American National Library of Medicine reflects this situation (Epidemics: 3 171 556, pollution 239 143, flood 26 539, heatwave 1 457, 4 903 882 for cancer). To deserve to be observed, deaths must be the consequence of an illness. The multiplication of data collected has made it possible to multiply their cross-referencing. A difference in life expectancy of 10 years between the richest and the poorest can be statistically proven (22,23), but it remains a noise until it can be broken down into different medical causes: alcohol, tobacco, drugs, obesity, diabetes, cancer, genes or epigenetic... Otherwise, it remains in the field of politics and economics, that of the IMF, which is accused of not doing enough in this area (24).

○ The public health description of the opioid epidemic in the United States (106,000 deaths in 2021) is a good example of this observation bias (25). Pain long remained irrelevant for care: It has little influence on the diagnosis and none on the treatment of the disease itself. Cured, a disease does not cause pain. For a long time children, like animals, were not supposed to feel pain (26,27). Measuring its intensity is a recent acquisition (28,29). In the 1980s, medical ignorance and morality pitted wrongly illicit opioids that caused addiction against legal molecules that did not. In the United States, a laboratory surfed and communicated on this belief (30). At the same time, the war on drugs leading to long prison terms for illegal drugs use, drove the demand for legal medicines (31). Focused on the immediate success of the prescription of Oxycontin, the laboratory was able to widely extend the prescriptions by "ignoring" the addiction they caused. A well-being, later a cure for craving, was sought which was not part of the prescription indications. For doctors, the productivity of these prescriptions (customer satisfaction and limited duration of consultations) led some of them to a "specialization" toward Medicaid recipients. If the laboratory's policy is reprehensible, the social context of this epidemic, described for example by Barbara Kinsolver (32), has hardly been addressed in the medical press. Most articles and editorials have emphasized the need for better regulation, better training of prescribers, and the need to find better treatments (33,34). Nonetheless Oxycontin

gone, long live Fentanyl whose reign is “due” to the Chinese (35,36). In my experience, interventions dealing with the social environment (community, education, employment, housing) are not only mandatory for prevention, but for the success of treatment. This problem is not specific to the USA, in France, where health networks, developed after the AIDS epidemic, they were abandoned because of the multiplicity of systems involved (social, justice, political, etc.). Social security refused to finance what it did not consider as care. My network was closed, whose doctors (5% of the whole) treated 50% of drug users in an agglomeration of more than 1 million inhabitants with better retention and a lower annual cost of 35%.

DOES PUBLIC HEALTH HAVE AN ORGANIZATION?

If, like all medicine, its object is disease, its function is to disseminate and promote scientific truths related to entire populations. This action has been qualified as prevention, ranging from primary prevention (preventing a disease) to tertiary prevention (reducing the consequences of a disease).

For more than a century, it was responsible for major improvements in people's health (appertisation, refrigeration, vaccination...). These first successes show that doctors are not necessarily involved and that correct medical theories are not mandatory. Today, its growing importance for politics is related by the realisation, from the early 2000s onwards, that the rise in healthcare expenditure was far outstripping that of GDP, and, that public health, reducing the number of patients would lead to savings (37-41). This utopia has not been realized: people rarely die healthy.

The organization of public health depends mainly on the state in rich countries (public health France, CDC, NHS, RKI, ISS, etc.). But not all countries have national organisations and public health surveillances. In China and India its organization depends more on local levels. Following the country, politics, economy... have a more or less influence on their aims and their communication. At the global level, the WHO plays this role. NGOs (CRI, MSF, MDM, Oxfam, CARE International...) as well as private foundations and donors intervene in certain countries who do not have these organizations or when they consider that their means are too limited. While it is easy to define the players in the healthcare system, the same cannot be said for public health (42,43). Strictly speaking, only professionals working in these organisations together with the public health professionals such as school doctors, should be included, but we can also consider that every social “organisation”, that

impacts behaviour, is a player in public health, from schools to families, with parents playing a key role. Following this rational, they should include education, media and social networks, emphasizing influencers. How to qualify Nixon's decisions to declare war to drugs, to create a committee on health education and the Environmental Protection Agency as well as passing the National Environmental Policy Act (44): Politics or public health? Is a company that advertises its electric cars a public health agent?

In order to clarify the place of these roles in public health performance, it is necessary to examine its relationship with medical research and the way in which its communication can be processed and understood.

Science as producer of medical truth

A look back at science is necessary before considering the functioning of public health, its subsystem devoted to the transmission of information produced by medical science. Science is the system to which the differentiation of modern society has entrusted the role of producing truths. It inherited from Greece its rational functioning and its use of mathematics to describe the world:

- The opposition of being and non-being with its logical principles of identity, non-contradiction and excluded third engendered essence and concept (45,46). Implicit in the use of core identities, almost absent, e.g., from Chinese with their continuous transformations (47), it refers to universal and eternal characters that everyone must accept.

- The birth of the subject in medieval universities made it possible to think of populations as quantities (48). It was going to translate not only on the cognitive level, but also emotionally (49) and unconsciously (50,51).

The certification of these knowledge as truth is entrusted to a consensus of experts and communicated in a subsystem of the mass media: the medical press with reading committee. This medical “truth” has consequences:

- While each new truth corresponds to a particular distinction, it participates in coherent wholes, specific to each system and subsystem. These paradigms rely on theories that limit what can be observed and understood at any given time. Their strength comes from textbooks, training and apprenticeship that present standardized views of fields and their histories: recipes are applied (52,53).

Like all complex systems, their strange attractors resist change: In the absence of a germ theory, Semmelweis's conclusions regarding handwashing could be overruled (54). Public health communication on obesity as a main component of health is not amended by the discrepancies of its use of BMI such as the better outcome of diabetics or the longer life expectancy of older adults (55,56). Did the obesity epidemic began in the nineteen thirties or the nineteen seventies? (57). The growth in the number of humans, the development of education and access to knowledge led to its exponential growth and to the need for more knowledge since its accumulation leads to more uncertainty (58). It is believed that 80 to 90% of all the scientists who have ever lived are living today and 80 to 90 % of all the scientific papers published have been published during their lifetime (59).

○ Science transforms the world it observes into numbers and statistics. For Public Health it is translated, for example, as:

- The systematic collection of health-related data. The irritations of its selection of risks and diseases is both the consequence and the cause of medical knowledge. In a world where nation-states are regaining importance, scientific production remains one of the only globalized resource. Public Health surveillance, organized at state level, by its continuous and systematic collection, orderly consolidation and evaluation, by the selection of its observation, has an essential role in the understanding of the impact of diseases on the health of populations. The covid-19 epidemic demonstrates the importance of this

selection. First, the novelty of the threat who may be faced with the relative oblivion of tuberculosis, which infects one third of the world's population and kills 1.5 million people every year, 2.5 % of all deaths in the world (60). Then, the controversy surrounding its origin in a laboratory in Wuhan at the end of 2019 ignores completely its possible detection in waste water more than 6 months before (61). Its absence from the medical literature has made it invisible. Similarly, reviews on the transmission of diseases such as influenza did not retain their transmission in the ambient air because convincing studies concerned guinea pigs and ferrets (62-64). The same expertise fought long before admitting this transmission and the frequency of asymptomatic cases for covid-19 (65,66). The multiplication of these data and their accessibility, which poses ethical problems, have multiplied the possible observations and publications. Statistical correlations take the place of theories. As with meta-analyses, size may create the illusion of greater reliability, masking local diversity and possible confounding factors or

ignoring relevant outliers. Given the problems encountered with the study of diseases, it is not surprising that the impressive impact of air filters on student performance did not trigger a public health buzz (67). They underline the difficulty encountered in understanding a complex reality.

- The establishment of thresholds that define what is normal and pathological. What threshold to apply to recognize a significance in statistical results, how to showcase co-founder variables (68-71)? The dialectical destruction linked to the confrontation of these limits with reality creates pressure to update them. How and when to measure blood pressure occasionally or continuously with which tools? Should its threshold be 13.9 or 13 mm Hg (72)? As the truth of these indicators require their evaluation over a period of time to validate their prediction, the introduction of a new variable takes the present as its origin and forgets the past. Since the answer cannot wait and the observation times do not exceed a few years, the results are then arbitrarily extrapolated to the duration of a whole human life or one has

to turn to animal models whose life expectancy allows to study mortality. Mice qualified as pests have not benefited, until now, from the ethical reflection limiting animal experimentation.

- The structural couplings between social systems and their environment explain that, contrary to what Kuhn asserted (52), their self-descriptions (theories), if they are not mutually intelligible, are not incommensurable. A few examples illustrate these relationships:

- The success of American medical research, like that of all its scientific research, can be explained by its history combining politics, economics and research. It is linked to the early development of higher education, the protection of innovations by patents and an industry initially protected by customs duties. These fruitful collaborations during the Second World War gave rise to an original operation of federal agencies (the CDC in medicine) which, through their funding, guided university laboratories by pushing them towards industrial partnerships by taking risks (73-77). The covid-19 epidemic aroused an unprecedented intervention of the states of which the 11 billion of the operation Warp Speed are an example (78).
- The medical press, like the general press, has undergone profound

metamorphoses. The increase in the number of submissions and growing criticism of the presuppositions of peer review (79) led to the demise of many journals that did not have sufficient sales, funding or publicity to survive. This excuse and the argument of their opening to a greater number of readers has created open-access journals whose publication is paid for by the authors. This system, which makes the best-rated journals the most expensive, accentuates the weight of the best-funded teams, regardless of their quality. In 2022, RELX (Elsevier) had a gross profit of 6.813 billion €, up 5.82 % on the previous year (80)

- The autonomy and growing influence of the economy allows it both to ignore public health messages and to make it evolve: Since the industry funds most medical research, cheap molecules in the public domain will have no chance of being developed: I could not find funding despite impressive results, obtained with the Lyon's Pasteur Institute, on a murine model of schistosomiasis with superoxide dismutase. On the other hand, I was able to observe by working with researchers from private industry that a number of results are

not published if they have no outlets. Patents are not filed. Shell's CEO is able to affirm the threats of global warming and to continue to invest in fossil fuels while keeping its promises to reduce its production by selling some of its assets (81). He is also considering his headquarters in the United States where the legislation is more favourable: Texas has just passed laws discouraging the use of renewables and propping up oil and gas. Blackrock, which had announced its desire to favour the green economy, has just integrated the CEO of Aramco on its board (82). The IMF is accused of not approving enough in this area. Old age, even in the absence of disease, is accompanied by a steady decline in physical and individual capacities. Considered a natural evolution, it is not qualified as a disease and has not been studied as such. Understanding muscle wasting that begins in midlife is just a statement of fact. It is only very recently, thanks to funding outside medicine by billionaires tempted by immortality, that significant resources have been released (83-85). It is also possible that the benefits of the commercialization of molecules whose

effectiveness would be demonstrated is one of the motivations of people accustomed to financial risks. Be that as it may, they are right because aging represents, along with global warming, one of the major problems with which humanity will be confronted.

- Law intervened in most countries to regulate relations between doctors and patients or industry. In a recent decision, the United States Supreme Court, limited the power of the Environmental Protection Agency which particularly concerns public health (85).

Finally, it should be emphasized that medical research, like all other social systems, eliminates a priori the observation of the world as a whole with, in the first place, the complexity of individuals. The experiences of people, sick or healthy, are mostly absent from the publications. They have been replaced by indicators (QALY or DALY). Calculating the cost of a human life makes it possible to forget troubling ethical questions (87). Randomized studies have been designed to prevent their results from being contaminated by the subjectivity of the people studied. Each treatment is optimized for particular diseases not particular persons. It is the daily experience of most patients. Faced with this blindness and the disinterest of the industry for molecules that cannot be patented or sufficiently remunerative, some patients are beginning to join forces to carry out their own clinical trials, but the industry also uses these movements to promote its products (88).

Individual reception of communication and (in particular) public health messages

Communication relieves and expands the cognitive faculties of living beings through the unity of a selection, a transmission and a reception (comprehension). Following Gregory Bateson, it implies a difference which makes a difference (89) in some later event, but to make a difference they must remain in the memory in short and long term.

As such, new becomes old, it conserves meaning but loses its status of information. It can also be forgotten: If the world can come out of its withdrawal, it can go back in (90):

Starting with orality, communication has undergone many transformations, sources and consequences of human evolution. Each stage of these transformations has been accompanied by profound upheavals in the societies in which they took place. However, this evolution did not make the first representations disappear:

- The study of orality revealed the first revolutionary transformation brought about by writing (91). It enabled accounting with its influence on trade, taxes, currency... but it was the alphabet that had radical effects. Previously, the realization that, outside magic, sound and meaning were not identical had to suffice. With writing, a distinction had to be made, not between sound and meaning, but only between combinations of letters and meaning. The distance between the thing written and the real object of writing opened the door to symbolization Luria's investigations in Siberia have provided a recent illustration of its impact (92). Books, memory as a predigested knowledge, was accused by Plato of dispensing with the need for personal reflection brought by the master-disciple relationship which ensured the power of the master and the continuity of knowledge, perverting the acquisition of knowledge (93,94).

- This move towards personalised understanding of the sources was subsequently encouraged by the confrontation of divergent opinions with the translation of ancient authors and their Muslim interpretations, access to well-stocked libraries and the invention of printing (95,96). It introduced society to realizing that a great deal more can be known and be familiar to someone or other than anyone can know. Reading could no longer be restricted to the subject matter of given functional systems. "Whoever could read the Bible could also read polemical religious tracts, newspapers, and novels. If the economy regulated what printed material was to be produced and sold, other communication spaces lost control over communication. Religion and politics were particularly affected, and they sought (more or less unsuccessfully) to defend themselves by censorship or the threat of sanctions ("libel" under common law and

complementary statutes). But this required decision-making criteria that could no longer draw on a common knowledge of the world but had to be developed and where necessary changed in the religious system, in the political system, and in the legal system in keeping with their specific functions" (97). The widespread literacy of the populations of the American states and the Paris region enabled both revolutions.

○ Throughout the nineteenth century, novels have provided models of behaviour (98) and science those of truth. Through the progress of technologies, sense-making of news and documentary reports, advertising and entertainment, mass media, became the first sources of adult knowledge not only of society and history, but also of nature. Marshall McLuhan could claim that the medium was the message (99). Mass media's technology does not allow interaction between sender and receiver. It uses unidirectional communication to construct their doubling of reality:

- While radio and television, through their ease of access, have made it more likely that a large number of recipients would listen to their information, they have put in place strategies to meet the economic need to increase their audience. Techniques already used by the written press have been gradually improved (100). The selection of news sought to use their novelty, their conflicting content, their digital measurement, their local inscription or their violations of norms. To make easier for the receiver to make an opinion, the

media favoured attribution to action, to actors, who, following their identity, served as tangible symbols as representative of a particular social group (men, women, people of colour, policemen...) (101).

- Entertainment followed two different and complementary paths: Film, television and now series suggest to the receiver that certain experiences are his own. The difference between the inside and the outside of the message becomes blurred, complex entanglements of real and fictional reality occur. Media fought to win and keep the attention of participants by offering them references back to their own life, giving meaning and models to their life. Imagined from real facts They proliferate. On the other side, to escape the thought of an uncertain future, a fiction market has developed. Their contents are culturally differentiated. If in China and Korea, heroes

must fight to succeed and conform to ethical standards of social order, in the United States, power (super heroes) and wealth are given and the characters must fight against a state incapable of organizing social justice. Unlike in the east, they almost always prevail. They replace novels to build role models.

The connection of this observation with what was known of the concentration of their management by the same financial and/or political interests, also present in other systems (science, education), together with unpopular political decisions explains the emergence of the popular success of the actualization of the Marxian theory of domination: From Pierre Bourdieu (102) to Michel Foucault (103) via Herbert Marcuse (104), Wright Mills (105) or Stuart Hall (106). It stirred the world of the 1960s and 1970s. This observation of society by a second-order observation was already one of the characteristics of modernity. Since the realisation that reality is nothing more than an indicator of successful tests of consistency, systematic deconstruction (107) has been and is still applied to question every source of authority including that of science and, by a return they had perhaps not expected, of the authority of the intellectuals. Transforming communication, the Internet changed the game: the transmission of information is no longer only downward. Each receiver can become a transmitter and vice versa. Since 1965, computer users have been able to exchange messages by e-mail. The first World Wide Web site was created in 1989. Free, these communications initially concerned only a small number of users, which increased with the number of PCs. But, it is widespread access to broadband Wi-Fi and smartphones that have enabled the revolution of social networks. Facebook, from 2004, began the creation of communities (108-110). Tweeter, Youtube, WhatsApp and many others would follow. Initially, one user could look up another and ask him to be « friend ». Once connected, the two could comment on each other's page and post messages. In 2006, the introduction of News Feed, drew from posts, photos, and status updates that users had

already entered into their Facebook profiles. It reorganized them into a unified feed—essentially, a continually refreshing stream of information a personalized hierarchy of “interesting-ness” that would dictates what each user saw in their individual version of the feed. Even if seven percent of users protested, this upgrade boosted Facebook's engagement. The epidemic impact of a person's change (happiness, depression, alcohol consumption) on their relations up to their third level, scientifically published since 2008 (111) was found again by Facebook (112), highlighting the impact of influencers. Following Tweeter, data becoming public, making the “global village”, imagined by MacLuhan more than thirty years ago, come true (99). It has been completed by the addition of clips and voice recognition. Reading and writing will not even be needed. With billions of users, orality was back with a vengeance, but the unity of the mythical tales has been lost before the multiplicity of its new bards:

- Speakers and listeners hear the same, and in hearing what he says, the speaker includes himself among his listeners. Metacommunication necessarily co-occurs. If someone has nothing to say, then it is not so much information that matters but rather keeping communication going at all”. Social networks “therefore obtain the necessary redundancies from the personal identity of speaker and hearer. From assumptions of consistency gauged from people and further processed in the schema of conformity and deviation, it limits the possibilities for conserving and remembering. “This means only that ” there are limits to the comprehensible everyday world at which questioning is discontinued or compensated for by a sort of defensive meaning. Such meaning has to be accepted; no recourse to texts is necessary and hence authorities who could explain what it is about. Further oral communication would merely meet with resistance against a hopeless undertaking (what can one say?) or with more or less circular confirmation of the accepted meaning” (113). “A great deal of communication takes place simultaneously (occurs and passes) and can therefore not be coordinated... The intelligibility ... depends on the given situation. There can therefore be few consistency constraints and hardly any postulates

of consistency monitoring and consistency assurance. If the entire world has become communicable, the framework of its knowledge is restricted anyway, so that agreement in substance can be assumed without further ado; there are few occasions and possibilities for making a personal effort in this direction”(114).

○ To generate the revenue they needed while remaining free for users, GAFA turned to advertising, selling data and activity of each user (108-110,116-119). Users were converted into shoppers whose comments would be shared with friends, generating more data for the networks and their clients. The Like button, by offering the possibility of scrolling through endless memes and its heuristically understandable evaluation of the performance of each communication, introduced an emotional dimension reinforced by the networks' algorithms. Users became addicted. TikTok and Snapchat are stuffed with videos from influencers promoting dish soaps and dating apps. And soon, Twitter posts that gain the most visibility come mostly from subscribers who pay for the exposure and other perks. “This preference of unrest over conformity and assent, especially when the threat it poses to them is emphasised, generates problems which require solutions which generates new problems which require new solutions, producing topics picked up as information. This one sidedness can be compensated by way of preference of moral judgements which have the advantage of not soliciting their understanding” (113). Since emotional reactions were the best source of buzz, their preferential use by network algorithms has led to the radicalization of many users amplified by the peculiarity of this oral society: it remembers everything. Forgetting is prohibited. Will it be possible to embark on a political career if a comment that could be considered racist in kindergarten has been found? The future of so-called decentralized social networks, that would give people control over the content they see and the communities they engage with, remains a problem even if we can think

that the founders still believe in it (120)..

The problem of communication of the scientific knowledge for practical applications remains to be solved. The scientific community has assumed this role, considering that the evidence of its truths should naturally prevail. A genetic oncologist, to whom I asked about the cost of his tests, replied "they just have to pay". An analogy immediately comes to mind with the role of the Catholic clergy before the Reformation with the Pope, the bishops, the Magisterium. Even with the support of a church, they didn't prevent schisms. Literacy is not the only variable to take into account, tossed into life, our first truths are pre-conceptual (121) and, outside our areas of competence our knowledge stops at the end of our studies (122). Illiberal democracies show a path ethically difficult to follow but at the time of fake news, the content of messages must be carefully adapted to the target audience. As the debates surrounding the emergence of nudge have shown, persuasion techniques are the subject of ethical debates that are not easy to resolve.

AI opens up a new area of information (123). For the moment, its offer of a growing extension of its memory capacities and the ability to process them mathematically gives rise to hope or fear that its uses could radically transform our future (124-127). Whatever the representation of human consciousness, AI cannot be described as sentient because the parallel reality it constructs, for the moment, is only linked to language: reading (hearing) texts and watching pictures. It does not feel pain, joy or sorrows. The surprising errors made by convolutional neural networks point out uncomprehensible differences between human and AI procedures. General-purpose AI seems, for the moment, out of reach. Today, it seems more necessary to question the consequences of the selection of what it learns than its relationship with human consciousness, (128). The practical questions posed by its use could give new relevance to scholastic debates around categories and universals. (129).

If today we can laugh when we read the reactions of the first spectators of the entry of a train in the station of La Ciotat, the experimentation of virtual reality has a much stronger effect of truth than cinema. This experience, comparable to a real experience. Transforming one's apprehension (130,131), is proven by the effectiveness of therapeutic deconditioning studies (132-135). We can already envisage a future where we will find our happiness in a virtual world inhabited by our favourite models.

For the moment, large language model generalized use, the ability to modify reality by inserting people into events in which they did not participate, the use of their voices or their image to transmit messages without knowing that it is a question of tricks is of much greater concern. Freedom of expression faces unprecedented moral consequences; Politicians seek answers. In any case, the productivity gains announced will transform the labour market.

PUBLIC HEALTH AND COMMUNICATION

The account of the evolution of my understanding of my professional practice is the best way I have found to explain the problems that public health must solve if it seeks to make its communication effective:

- Despite my healthcare education, I have learned that its selection and communication of scientific information is no more universally accepted as truth and does not entail an obligation to follow its recommendations. At the end of my cursus, I was made to believe that medical truths were self-evident. Conditioned to learn a world simplified by mathematical statistical translation, changes did not question their new validity. I was convinced that confronting a health problem systematically led to the consultation of a doctor whose prescription had to be followed. I had to discover, when offering HIV and hepatitis screenings and treatment in drug treatment facilities in the late 1980s, that they would not be accepted by everyone, far from it. I was not alone: A European working group (Pompidou Group) on drug addiction wrote at the time that the problem of drug use was ignorance of the existence of health care structures. In 1989, I was able to show that they were wrong: Most contacted the drug services but did not come back. Their offer did not match DUs' expectancies. Nevertheless, in the 1990th, an eminent French expert had to be confronted with a discrepancy between the results of the clinical trials of HIV triple therapy and those of her consultants to realize that they were not always compliant.

- Each professional must demonstrate its efficacy, mandatory to create the trust for each commitment. Through a thesis questioning them about the experience of their illnesses, I had to accept that the explanations that I gave at the time of their screening, explanations whose content I had fine-tuned at over the years, were of little importance for their access to care. It was the assumption of responsibility by the team, providing concrete proof of their desire to help them, which had been the driving force behind this commitment.

They were trusted. This made me understand an observation of the specialized care teams for drug use of the 1970s, of frequent requests that were outside their skills. Unable to concretely assess the quality of the psychotherapies offered (there was no substitution), addicts were testing the reliability of their proposals with requests easily verifiable such as housing. As today, the symbolic function of professional status was no longer sufficient to create trust.

- Rational explanation is not always sufficient and may, even, be counterproductive. The life-world is transparent to a first-level observer, it is the issues that challenge his understanding. We spontaneously proceed to heuristic approaches in our search for answers (136). Using calculations to validate our conclusions is not natural. Primitive societies content themselves with counts not exceeding 3 or 5, any higher numbers being considered as many. Greece and India developed mathematics, but it must be remembered that zero did not appear in the West until the 12th century. The commonly used graphs and histograms correspond to a geometric presentation of algebra invented by Descartes. Advances in mathematics have often provided solutions to problems posed by concrete situations. They require paradigm shifts (137). I understood that money was a debt thanks to the description of the balance sheets of a Florentine capitalist of the XIVth century (138). In "The Wire" series, the use of drug deals makes it easier to understand these calculations. The Pascalian wager (139) is the first philosophical use of nascent statistics. It offered the possibility of mastering the distress induced by the "madness" of every decision (140), turning it into a risk that can be thought. The realization that access to these sophisticated representations is only possible for a limited number of individuals makes it clear that their use as explanation is often counterproductive. By presenting a rational construct as an obvious explanation the interlocutor "has to" understand. Claiming to know better than himself what is good for him, it denies him as an individual. Feeling despised, he will refuse to make the slightest effort to commit to what is proposed. Fear of consequences may also block thinking and even have physical consequences: The fear engendered by the discovery of their HIV infection triggered transient homonymous lateral hemianopsia in some of my patients. Regardless of their understanding, the proposals must be feasible. When you can't afford the five fruits and vegetables that must be eaten every day for Public Health France, is there any other solution

than to deny its veracity? Medical societies have abandoned screening for asymptomatic diseases for which there is no treatment.

○ Message consistency has now been lost. Once media were believed to be neutral. More recently, this aim has been abandoned with an increasing number of information whose validity poses a problem of attribution. These “fake news” can be interpreted as too old or too new scientific truths, unfalsifiable cultural beliefs or deliberately false information. It is often impossible to decide except in favour of the most emotionally acceptable proposal. If we consider only the field of diseases, the results show that public health has had little impact from its communication: almost half of hypertensive do not know they are hypertensive (141), screening by health centres has no impact on the health of the population and may even be harmful (142). The resumption by the general press of information from the medical press as “News” has oriented its publications towards the sensational as was the case with covid-19. The publications of successive contradictory publications and the inconsistent communication from reference organizations such as the WHO or the CDC during its outbreak played into the hands of sceptics. Their recommendations on isolation, masks and vaccines were challenged. This situation demonstrates the lack of interest of public health for an effective communication and the limits of its impact.

Effective public health communication can no longer be content with presenting “obvious truths”. Communication to be effective must be carefully prepared to be adapted to the target population. It must also be based on experiments of the same order whose success is proven or associate relays which have proven their reliability in other fields. Experiments conducted at scales adapted to the project have demonstrated their interest. In each case, the relationships with the target must be interactive.

Conclusion: Health is not merely the absence of diseases (WHO)

Public health is not a failure. We must not forget the tremendous advances that this approach has brought to humanity. Rosling has reminded us that it's easy to overlook them (122), even if they may be related to a world that no longer exists (143). It must adapt to the transformation of the world, which requires to consider health from the larger angle of the definitions of international bodies:

○ As the subsystem of medicine responsible for communicating about disease, its

mission remains relevant in the light of advances in medical science. The threat of viral epidemics, the resistance of bacteria and parasites to antibiotics, the risk of fungal diseases (144), early detection and new treatments for diabetes, cardiovascular disease and cancer are concrete examples of this need. Ageing should also be included in this field of application. However, their cost will limit their use, at least for a time, to the wealthiest, who may feel less need to invest in the necessary systemic transformations.

○ Global warming with its tornadoes, floods and heatwaves, pollution, invasive alien species (145), poverty and conflicts although not diseases, have a clear impact on the health of populations. Observing them solely from the point of view of disease is not relevant either to prevent their occurrence or to manage their consequences. A holistic approach that goes beyond the compartmentalisation of social systems should be tried. The limits of structural couplings need to be overcome in an attempt to gain a global understanding, which the promise of generalised artificial intelligence could facilitate.

○ Simply passing on knowledge is no guarantee that it will be followed. Reality is not subject to consensus anymore. It has become evident that the peaceful intercomprehension of Rawles (146) or Habermas (147) is nothing but a wishful thinking. To be believed, and then followed, the receiver must have confidence in the sender. His status as a politician, economist, forensic scientist or doctor is no longer enough. This is all the more important when, as with covid-19, the results depend on consistent behaviours. This confidence, which depends on the belief in the ability to predict the future, can only be acquired through concrete successes, obtained more easily through local experiments adapted to specific situations, a source of examples for other experiments, the accumulation of which will be capable of mobilising an entire population (148,149). Collaboration between individuals and organisations have proven their efficacy (150-152). The development of an accepted hegemonic representation will be necessary to overcome the challenges facing humanity.

Faced with the anguish caused by the Thirty Years' War, following the Wars of Religion, the scientific method shifted the focus from the knowledge of an Adamic past (154) to that of a natural world understood by the human mind (5,139). It produced the modern society and its organisation around differentiated social systems which have allowed an

unprecedented development of humanity's seizure of power over nature. This segmentation can be seen as the main cause of the problems we face today. Artificial intelligence now appears to be the new utopia. By enabling all human knowledge to be indexed inside a single database, combined with the computing power of quantum computers, it

would offer us the possibility of an upcoming singularity (155), finally unlocking the secrets of nature and its "invisible hand". Whatever concerns it may generate and the promises of technology (156), the process has already begun and will transform society and, consequently, public health. A return to the past is no longer possible.

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