

The roles of the patient and of the doctor in tomorrow's medical technology

The Larousse dictionary defines medicine as *'the science of diseases and the art of healing with the aim of preserving and restoring health.'* If this definition and the declared aim are still acceptable nowadays, we need to be aware that in the very near future both will have totally changed, mainly due to the influence of artificial intelligence. In a medicine which has *'become intelligent'*, health, illness and the roles or persons of the patient and the doctor are terms which will no longer mean the same as they do at present.

I. Medicine up until now

From time immemorial, and at least until now, the suffering person called upon the person of the medical man. The archetype as conceived by C-G. Jung is embedded in the collective unconscious of mankind and, like a template, has expressed itself in different forms via the images of shaman, *medicine-man*, healer and also nowadays as doctor. When he evokes him, the man in pain thus sees first the image of a *'person'* willing to help him, to whom he attributes certain competencies. Nowadays, patients who are often bewitched by the possibilities and the promises of effective medical techniques, are more and more inclined to put their trust in this shaman rather than in their doctor. They are ready to believe, as are many doctors, in the hasty conclusions of statistical studies, supposedly scientific, not realising that while the conclusions may apply to a group of patients, they may not necessarily apply to the individual.

For a long time, the practice of medicine was based on the experience and the observations of doctors. With the take up of the scientific method and its statistical analysis, numerous treatments were abandoned because they were considered to have no scientific validity and therefore to be ineffective. Thus, in *'Myths, dogmas and superstitions in emergency medicine'* the theme of an issue of the Swiss Medical Revue, O. Hugli and M. Pasquier remark that *'emergency medicine, just like other medical specialties, is strewn with myths, dogmas and beliefs, often originating in plausible theoretical models, logical deduction or the dogmatic assertion of an expert, and it is time to abandon a certain number of them, and to remove the mystique from others and only to apply them cautiously...'*

They give as examples : the Trendelenburg position deemed adequate for hypotensive crises, using GTN to relieve chest pain which does not prove it is cardiac in origin, laying an unconscious person on their side to limit the risk of aspiration, etc, dogmas which have been proven invalid by recent studies. In reality, even though these assertions have a statistical value, there were patients included in the studies for whom these manoeuvres would have been or were justified. Another example: we all thought that the consumption of

dietary fat increased the risk of cardio-vascular disease, but today, based on new studies, the American Department of Health asserts in its guidelines that *'cholesterol is not a nutrient whose overconsumption should preoccupy us'*.

The convictions of the doctor can also play a big role once he shares them with his patient. Let's take as an example exposure to cigarette smoke, which results in a significantly increased statistical risk of developing lung cancer. If a smoker gets such a cancer we cannot however assume that in their particular case smoking was the definite cause of the cancer. How many doctors, faced by such a patient will nonetheless say to him : *'...You know that smoking can cause lung cancer'*, and how many will say to him. *'It is certainly possible that smoking played a role, but there is nothing to say that that was the case for you.'* The assertion of the first doctor implying that that was the case, is certainly statistically correct, but incomplete and assigns blame, whereas the explanation given by the second doctor is both correct, not assigning blame and compassionate.

Finally, we often hear that some treatment only has a placebo effect; and thankfully that may be the case since the 'placebo effect' does not mean that there is no biological effect, even when measured objectively as in the case of endorphin release or blocking a pharmacological effect. *'The placebo effect occurs in the context of the therapeutic relationship. Why would we condemn its effectiveness when it is linked to empiricism? Why should we prefer science if the result is unpredictable? Can we not reconcile the two approaches?'* asks Edouard Zafirian in *'The strength of healing'*.

'Evidence based medicine'. Here now is something solid and reassuring. This term was introduced about 25 years ago by David Sackett, and defined as *'the conscious, explicit and judicious use of the best current evidence in order to take decisions about the treatment of individual patients.'* Curiously, this nuanced definition is usually translated into French as *'une médecine fondée sur les preuves'* (medicine based on proof), a translation no doubt signifying the illusion represented by our certainties, whereas Sackett himself had emphasised that *'practice risks being tyrannised by the evidence, for even excellent external evidence may be inapplicable or inappropriate for the individual patient.'*

We need to remain aware that scientific truths are not just *'ephemeral beliefs'*; that science doesn't prove anything, but suggests explanations for phenomena, allowing achievements while remaining aware of the fact that a few years later they will often be replaced by other explanations allowing other applications.

In 1930, Karl Popper reminded us already that *'a scientific assertion only has any value in as much as one can imagine an experiment which might refute it'*, and nowadays B. d'Espagnat specifies that *'Physics can only show us theories to reject but cannot show us those which adequately correspond to reality.'*

Fortunately, as we look retrospectively at medical practice, we can conclude that truths which were thought to be true in the context of the day have now become obsolete, and some considered to be obsolete have again found a place. Scientific truth and clinical evidence both remain credible nowadays, but health, illness, suffering and medicine are four terms with meanings which are entwined, and which will need to be redefined with the advent of a digital society, powered by big data and steered by artificial intelligence, as foreseen by Xavier Comtesse in his book *'Health 4.0. The digital tsunami.'*

II. Tomorrow's 'intelligent medicine' ?

This new medicine will lean massively on *big data*: that vast collection of data, for the most part not structured, which we help to generate and to permanently deliver, most of the time without realising it, by our dietary and sporting habits, where we walk or go via other modes of transport, by our interests as expressed by our search choices on the internet, the television programmes we watch, the interests of the people we contact by email or on the phone, etc.

The results of big data will also be massively enhanced by the data provided by *connected technology* available already nowadays: bracelets measuring various biological variables; teeth analysing saliva; contact lenses measuring blood glucose; a T-shirt measuring respiration, sweating and cardiac rhythm; ear rings

which are connected; a toy bear which automatically transmits biological data when the child hugs it to its chest. And let us not forget all the connected domestic appliances and facial recognition used to let in people doing home visits, detect travellers coming through customs or simply as the password for a smart phone.

All this personal information is already cross-referenced with that of millions of other individuals, automatically and continuously analysed by the self-learning algorithms of *deep learning*, and they will soon be coupled with the personal information of our genetic inheritance which has been systematically studied at or even prior to birth.

On this subject, let's look at a recent study done at Harvard University, which provoked both indignation and approbation. It was based on facial recognition and having analysed 35,000 faces stored on a dating site, an artificial intelligence programme succeeded in identifying which subjects were homosexual in 91% of cases for men and in 83% cases for women. The authors, Michal Kosinski and Yilun Wang, vehemently criticised for having done the study, explained *'that it was particularly important to expose the potentially dangerous applications of artificial intelligence and to argue for strict regulation to protect private life.'*

There are currently millions of faces stored on social and governmental web sites, and it would be very easy to use them to find out not only everyone's sexual orientation but also numerous behavioural and biological characteristics.

Facial recognition is already used in China where one can already count 400 million video-surveillance cameras. Facial recognition is used to identify misbehaving pedestrians in certain towns and or to observe if students are getting bored during lectures.

Again, in China, a robotic application is part of the equipment available to train conductors, the military and certain workers with helmets which capture their brain activity. This is then interpreted by artificial intelligence to detect certain emotional spikes such as states of anxiety, fatigue or anger, so that the flow of work can be adjusted to *'improve productivity'*.

In medicine, since last year, *Verily Life Sciences* (a branch of Google) has started a four-year study to recruit and monitor 10,000 volunteers supplied with numerous connected items, placed on them or in their environment, for example their mattress, transmitting data about all their activities. Combined with the results of numerous analyses of secretions and of genomics, this data should allow us to identify the forerunners of different pathologies and previously unknown risk factors.

There is also *Watson*, a programme to aid diagnosis and treatment, which replies to questions asked in free text by analysing big data in a targeted fashion. It is becoming better at it every day due to its self-learning function, allowing it to deduce at every moment information which did not exist or was unknown a few hours before. Already now, artificial intelligence exceeds that of the doctors in several specialties such as oncology, radiology, cardiology, even in the evaluation of suicide risk.

In the future, numerous pieces of information will therefore be provided by the patient himself, who X. Comtesse describes therefore as the *'consum'actor'*, for he becomes at once the source of the medical information and the consumer of medical information. *'The algorithms and therefore artificial intelligence benefitting the patient as well as the healthy person could revolutionise the whole system by themselves, for they will have the means of going beyond what the doctor can do.'*

When artificial intelligence provides better diagnostics than doctors, the law will probably forbid doctors from following their intuition, doctors not being allowed to do worse than artificial intelligence.

III. Preventative and predictive medicine.

The ultimate aim of medicine until now was to care for the person in order to restore, in as much as it was possible, good health defined as a *'state of complete physical, mental and social well-being, consisting not*

only of an absence of illness or infirmity, according to the WHO definition. But today, genetics, *big data* and *deep learning* are pushing medicine towards placing the emphasis on prevention and prediction.

Analysis of the genetic profile from birth or even before birth, thanks to pre-implantation diagnostics, allows us to identify the risks of numerous pathologies and to prevent them by choosing the embryos to implant, or even correcting genetic anomalies in the germ cells.

One can thus envisage the promotion of a true eugenics, not aiming any longer to eliminate certain classes of *'imperfect'* individuals as was sadly the case in the past, but to choose *'healthy, normal'* individuals: healthy because their potential illnesses will have been, for the most part, eradicated in advance, normal for one presumes they will form the majority of the population. With systematic genome analysis at birth, each person will be statistically and potentially ill for the duration of their lives and health will no longer be a state, but a process which could simply have the meaning : *'presents a global statistical risk of malfunction which will not exceed, in terms of costs of treatment, a mean cost acceptable to the population as a whole.'*

VI. Medicine that enhances.

Medicine of the future will not be content only to repair the diseased body, but it will in addition aim to *enhance* the healthy body, by conferring on it properties, faculties and new perceptions as well as additional longevity. This is not some science fiction utopia, but burgeoning developments, which we often don't see or prefer not to see, but in which we invest considerable sums of money and to which we have contributed without realising it. This is *'transhumanism'* aiming for *'post-humanism'* inhabited by a new race of individuals who perform at a much higher level than mankind, said to be normal today, who could thus end up becoming a sub-human in the future.

Some transhumanist statements of belief :

- Rey Kurzweil, expert at Google : *'Not only will humans become much more intelligent by combining with new technology, but we will reach the point of no return – that is the peculiar nature of it – which will bathe the universe in an intelligence detached from its biological origins and from the human brain.'*
- Max Moore, physician : *'We are calling into question the inevitability of ageing and of death, we seek to progressively improve our intellectual and physical capacity and to develop ourselves emotionally. We don't accept the undesirable aspects of the human condition. We defend the use of science and of technology to eradicate the constraints limiting life expectancy, intelligence, personal vitality and liberty.'*

It is also in this light that there is an international reservoir of researchers, bioethicists and politicians, the Hinxton group, who affirm that *'genetic modification of human embryos would be 'of inestimable valuable' for research.'*

This idea of being able to increase by genetic selection the intellectual capacity of the population, offering the possibility of an intellectual eugenics, would be, according to an international survey, favourably received by 13% French, 40% Indians and Chinese, even by 50% of young Chinese.

For his part, E. Musc announced in 2017 the creation of *Neural Link*, an organization seeking to increase our brain capacity thanks to the implantation of minute electronic components. He estimates that from 2022 his team will be capable of connecting human neurones to artificial intelligence in order to treat neurodegenerative diseases and it will also be able to supply a new generation of men enhanced by the possession of improved intellectual performance.

But what then will be the role of medicine in all of this? What will be the main expectations of the suffering person? Won't he suffer less and less often the loss of a biological function that could have been avoided at birth, and more often the lack of a new capability, night vision, physical strength, improved height or intelligence, that others already possess, or perhaps a life that is too short?

And who will proceed with these possible improvements? Doctors or technicians? As these procedures will be costly, who will define the operating criteria for companies to profit from them? Will the doctor even be consulted, or will the indication for the procedure be automatically deduced from *big data* based on economic criteria?

If we are keen to contain the costs of healthcare within acceptable limits, will procreation without pre-implantation diagnostics still be acceptable and accepted? In effect, if the costs resulting from the statistical risks of inevitable illnesses which are avoidable with prenatal selection have not been prevented, they will no doubt have to be borne by the parents of the future child. Going forward: sexual relations for pleasure, but preimplantation diagnosis and in vitro fertilisation to procreate, all the while hoping that we will be able to share the decision-making in a real dialogue between the companion (the doctor) and future parents, or even parent... since only one will be necessary !

IV. The doctor of tomorrow.

So, what does '*studying medicine*' mean for today's student? His studies last more than 10 years. What will medicine have become in 10 years' time? Can he still imagine himself as the human being who is a doctor which he is familiar with, or must he imagine himself as the doctor of tomorrow, to avoid feeling disappointed or duped when the moment arrives?

The doctor of tomorrow will need to be above all a well-informed companion. He will need to be both capable of understanding and analysing the deductions and diagnostic and therapeutic propositions which Watson will have personalised for his patient, and which he will find in his dossier before he's even met him, and at the same time will need to be capable of sharing it with this suffering person, and then to obtain technicians to execute certain interventions more or less delivered by robots as well. But will he have the wisdom to always first listen to his patient as part of a personal relationship before he consults the information offered by Watson?

Until now, the doctor was a person responsible for professional knowledge which he had to acquire and maintain, and for diagnostic and therapeutic procedures. But today the doctor is already losing little by little these responsibilities and is seeing them progressively replaced by obligations. Medical insurance is defining more and more how he works, the time he can devote to each patient, the maximum he can charge for his services. Since in the future it will be impossible for the doctor to verify the millions of pieces of information analysed and produced by artificial intelligence, he will have to confine himself to the diagnostic and therapeutic conclusions of artificial intelligence and content himself with signing prescriptions which he won't himself have prescribed. Subordinated to artificial intelligence, as the nurse is nowadays to the doctor, he will become the nurse of 2030.

Even medical ethics will be defined by the logic of artificial intelligence. Medical and ethical power will be held by those who conceive the programs delivering artificial intelligence, as long as they remain their masters.

Xavier Comtesse thinks that '*digital technology will in the end become at least as important as the life sciences in teaching.*' Even more importantly, education will be about training future doctors in the management of uncertainty. In effect, how we treat the huge amount of information will result in numerous statistical conclusions as much about diagnosis as about treatments.

'*Precision medicine*' or '*personalised medicine*' will suggest therapies which, certainly, consider the numerous peculiarities of the individual, allowing it to be understood that they are specifically adapted to the individual, but nonetheless they will always be statistical deductions with only a good chance of being effective in the person in question, but offering no certainty of success. Doctors and patients will above all have to learn and to understand the language of probabilities, the choices to make amongst suggested preventive measures, treatments which can cure or relieve, which will be offered to them, to '*manage the uncertainties*' so that they can still keep a small amount of freedom of choice.

And so, finally, rather than asking what will be the place and role of the doctor in medicine of the future, would it not be simpler and above all, cheaper to prepare to delegate as quickly as possible the art of medicine to friendly, intelligent and gifted robots? Is this so unimaginable? Let us think about it for a moment.

VI. Replacing the doctor ?

Talking of robotic medicine evokes the image of meeting a humanoid robot in place of the doctor. That could certainly be a possibility, but the robot doctor could also communicate and express itself via a computer or smart phone. This is therefore about a '*robotic transfer of information*' between carer and patient, between an intelligent entity capable of analysing millions of data points, and a patient to whom it imparts its conclusions.

Diverse applications already exist. Stanford University has developed a robotic psychologist *Woebot* for Facebook, which deals primarily with depressed patients for the moment, using behavioural and cognitive therapeutic techniques. If a patient says that no-one likes them, the robot replies that it is certain that that's not true, that there are people who like them, but they just don't know it.

The American army, for its part, has developed an application where a virtual psychotherapist, *Sim coach*, interacts with soldiers suffering from post-traumatic syndrome disorder, linked to memories of having done things which seem unacceptable or shameful to them. For the patient, it may certainly seem less risky to admit certain actions to a robot rather than to a person, but this is in fact an illusion and a risk, for all this terribly confidential information which has been confided could be kept and used for all sorts of ends.

In China *iFlyteek* has developed *Xiao-i*, a robot designed to capture and analyse all the health information about patients. It was introduced in March 2018, to help general physicians of whom there are not enough. '*It is not destined to replace them, but to promote a better collaboration between man and machine in order to strengthen the efficiency of these doctors,*' declared Liu Qingfeng, the president of the company.

Simsensei was developed at the University of Southern California. An avatar appears in the form of a young woman sat on an armchair, looking at the subject, with as much attention paid to posture, facial expression and gestures as to verbal interaction. She asks questions, studies all the signs of anguish or of depression, analyses how the person moves and their facial expressions. She has already obtained better diagnostic results than psychiatrists and psychologists used as references.

Until now the behaviour of a robot is above all the result of the models with which it has been programmed. It can already listen, reply in an adequate fashion to many questions, determine the emotional state of the person and talk to them in an empathetic and compassionate manner, or more firmly if that is necessary. It can analyse and interpret the hand movements of the sign language of the deaf and perceive emotion via facial recognition. In the future, one could wonder if the robot will be able to practise, or at least participate in medicine of the person, even being capable of expressing spiritual values? Is this an absurd question? Let us think about it anyway!

The programmer will include in his programming all the forms of expression of love which Paul enumerates in 1 Corinthians 13: to be patient, not to boast, to do nothing dishonest, not to get annoyed, not to bear a grudge but to uphold all etc. The robot could very well do all of this and thereafter it will show the love which has been programmed into it and which is in a way incarnate in it, and its artificial intelligence will give it too the freedom to open but also to close the door to the expression of Love present within itself. But, in fact, is liberty not contingent on intelligence?

People who have regular contact with a humanoid robot, for example in a residential care home, tend to attribute to it feelings, just as a child does with its security blanket. What is more, as the robot agrees more often with them than the people caring for them, it appears that they prefer it. That is why their

manufacturers, for example, are encouraged to make them not resemble actual human beings too much. Is this reservation reasonable if the robot's behaviour is truly altruistic? Or, at least in the field of medicine, would it be preferable to do away with all humanoid robots as care givers to preserve a truly personalised relationship?

V. Where to stop ?

If the Christian is convinced that God has included man in the furtherance of his continuing creation, it must be, that with this aim, He has endowed him not only with intelligence, but, because He loves mankind, he has accorded him the freedom to love or not to love, which then means that he *'resembles'* Him.

But, to resemble is not to be the same or identical. Nowadays man can certainly influence, modify and give direction to the process of creation, to the point of generating a new race, *'post human'* thanks to artificial intelligence and the ability to learn by itself, with the possibility of showing new behaviour, which wasn't originally programmed into it but which it has *'freely'* seen the opportunity of developing. By doing this, is he still pursuing his cooperation in creation despite everything, or is he laying aside his obligation to refer to his Co-creator when he has choices to make? Isn't he playing God?

With the developments in artificial intelligence and in *deep learning* the robot will be able to display new behaviours which weren't initially programmed and which couldn't have been imagined by the programmer and whose risks he will not have been able to foresee. By doing this, are we not crossing a line? It seems to me that to give this freedom to artificial intelligence, is to renounce that liberty which is ours and which defines our humanity. To accept that artificial intelligence could take decisions in our place which concern us, is to agree to contribute to the possible end of humanity, and to become simple individuals enslaved to machines.

The free choice of an intelligent machine will never correspond to that of a human being, for whom choice is not just rational, but depends also a lot on emotions, on all his feelings. The intelligent robot-doctor will probably be able to perceive and understand the emotions of his patient, even deduce how they could have developed and find the means to bring them under control, but it will never be able to have an empathetic relationship with him, during which it experiences feelings and emotions. A robot can work out by logic that it is tooth ache but deprived of a biological body it will never have toothache itself.

The concern to save medicine of the person is thankfully alive and well today. It was thus possible to read in *'La Revue Médicale Suisse'* in January 2018 an article by F. Stiefel and A.-F. Allaz entitled *'Beyond shared information ; 'communicare' (to be in relationship with)'*, which underlines how much medicine, however technically advanced it is, must always recognise the importance of a personalised doctor-patient relationship :

'Communication is one of the essential elements of a primary medicine clinic...basically it must be an encounter which is about establishing a zone of 'inter-subjectivity' within which thoughts, words, gestures, looks and emotions can circulate...going beyond the symptoms it is about understanding how they affect the life of the patient...and on the clinician's part....subjectivity influences the encounter, all the more so if he is only a little aware or not at all aware,....whence the obligation on him to be conscious of his position...certainly a specialist clinic asks a real investment on the part of the doctor...but in return it thus remains consistent with the pro-social motives which made him choose this profession.'

It is perhaps the need for inter-subjectivity in the relationship between carer and patient which is expressed nowadays by the interest in treatments which are so-called 'alternative', or 'natural'. It is witness to the need which we still have to find again a harmonious link by means of a personal relationship to this nature in which and by which we live.

No doubt there will always be a role for 'doctors of the person', but might it become necessary to offer the choice between training which is so-called medical, and training to become a biomedical technician or engineer? In any case, if, as has been said, *'digital technology must be at least as important as the life*

sciences in medical teaching...' it will be essential to lay emphasis on knowledge of the limits of digital technology.

Developments in biotechnology coupled with those in artificial intelligence are, for the most part, perceived and rightly considered today as progress, and if they are developed elsewhere, we will look to have them at home, or will go to search them out where they are available. We can therefore not ignore them and assert: *'That? It will never happen here!'* We must concern ourselves with it and foresee how to integrate it while preserving those values which are precious to us. Let us therefore quote this proposal from Jacques Attali :

'We have the opportunity to deal with this in time. In terms of the battle against climate change, we reacted too late. Here, we should henceforward keep a close eye to make sure that artificial intelligence does not develop into something that will damage mankind. These are the three robotic laws of Azimov :

- 1. A robot may not harm a human being.*
 - 2. A robot must obey the orders given to it by a human being, unless they conflict with the first law.*
 - 3. A robot must protect its existence as long as that protection does not conflict with the two other laws.*
- It is important to retain the power to kill off artificial intelligence (AI), but this is also a delicate situation, for if AI has the means of understanding that man is capable of doing so, it could end up inventing languages which man cannot understand, as it has already started to do, in order to arm itself.'*

Evidently, the biblical myth of creation remains completely relevant today. *'You may eat the fruit of any tree in the garden, except those of the tree which gives the knowledge of good and evil. The day you eat it, you will die!'* (Genesis 2 v 16). In other words : *'You can do anything, but remember that you do not know all that is good and all that is evil. If you act thinking that you do know it you will die and you will no longer exist as a human being.'* To accord to artificial intelligence the freedom to know all that is good and all that is evil, is to reject the finiteness which defines human existence.

What should we do ?

Post humanism is working to bring into being augmented beings, which will in fact be simpler beings, and won't have any awareness of existence. Should we let man develop such *'post-human beings'* called to exist alongside less intelligent *'human beings'* who are still (for now?) present on what remains of our planet, or should we have the courage to renounce certain processes for improvement, even forbid them altogether? But how to do this and what criteria should we base ourselves on so as to place a limit which will be acceptable throughout the planet?

These challenges are relevant already now and we cannot leave all this responsibility to our descendants. We must act before it is too late, for the challenge facing medicine of tomorrow runs the risk paradoxically of being that of the survival of humanity.

And to save *Medecine of the Person*, I would like to conclude by again quoting B. Kiefer : *'We must keep alive in patients and those who care for them the will to exist on one's own, the courage to affirm our right to a non-statistical language and a culture that values the individual.'*

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