

EDITORIAL

New year with medical innovations. What does the Editor-in-Chief hope and worry the future will bring to healthcare?

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Happy New Year to everyone. I am a huge science-fiction fan and an avid literature reader. What I once thought to be literary fiction has come to be true. I don't mean the touch screens, flat TV's and computers the size of a phone. And I also don't mean the joy related to the reactivation of the Star Wars saga.

I once read a piece about a society living in a highly polluted overpopulated world, with small crowded spaces, where the air was purified. I will not give out the answer what book it was, but rather make it a riddle. Well that unfortunate science-fiction has not become science but has become the reality, at least that's how I feel. Every day the streets of Cracow are suffering from huge traffic jams, we are then locked-shut in tight spaces at work owing to the overwhelming smog, due to the winter heating season. Our children suffer the same fate, mostly indoors – in nurseries, preschools and schools – very often equipped with sophisticated 4-in-1 room air purifiers. One needs no researcher or doctor to realise the fact that all these pollutants and particles not only offer allergic, infectious but also

neoplastic consequences on long-term exposure basis. For me as a person working in microbiology, one needs to only relate to the fact that any damage to the mucous membranes of our body, whether physical or chemical, would render us more prone to infection. Most attributes of carcinogenesis involve not only recurring inflammation but also errors in the genetic code, also due to many external factors.

What are my hopes and concerns for the future when it comes to medicine and medical technologies (Table 1)? When it comes to current problems of drug resistance in microbes already prognosed by Fleming – we will definitely move ahead, also when it comes to the treatment of biofilm infections – but so will the microbes. Thus far we know quite a lot about these structures and we also know they are highly resistant to commonly used antibiotics. If you want to read more on biofilms, the European Society of Clinical Microbiology and Infectious Diseases have quite recently published guidelines worth recommending, in the journal *Clinical Microbiology and Infection* [1].



Below is my special list in which I try my best at chronological approach to novelties:

Table 1. Future medical technologies and discoveries as prognosed by the Editor-in-Chief for the new millennium. Discoveries marked with an asterisk * signify Nobel prize.

Time scope	Breakthroughs
Within 5 years	Common use of smart-technology to monitor vital signs in chronically ill
Within 10 years	Balloon drones used commonly as rescue/medical aids, both in water and high altitude
Within 15 years	Highly effective biofilm therapies (HEB)
Within 20 years	Effective yet cheap malaria vaccine *
Within 30 years	HIV vaccine *
Within 40 years	HIV/AIDS cure *
Within 50 years	High altitude rescue craft
Within 100 years	Human cloning
Within 150 years	Universal transplants of cloned organs
Within 300 years	Breakthroughs in robotics, AI and nanotechnology
Within 400 years	Medical pod/capsule
Within 500 years	Advanced space travel medicine
Within 1000 years	Disease-free mankind
Beyond 1000 years	Life-extension procedures – i.e. studies on immortality

Legend: AI = artificial intelligence

What lies ahead are the vaccines against the incurables. Definite Nobel candidates are the persons or rather teams that will come up with the vaccine against *Plasmodium* spp. and HIV as well as the cure for HIV/AIDS.

When it comes to drones, we recently had an example of such technology saving lives off the coast of Australia. If you come to think of similar but more powerful tools, this could well be used for rescue missions in Himalayas, to bring gas, oxygen, etc (Fig. 1). I'm writing this article when the public opinion in Poland clings on the hope that one Polish climber is still alive in Nanga Parbat.

Despite the fact that the highest parachute jump was made from over 41 km by Alan Eustace in 2014, and the highest helicopter rescue was made by a renowned climber Simone Moro and helicopter pilot Maurizio Folini from an altitude of 7 800 m (top altitude reached by a chopper was over 12 km in Aérospatiale SA 315B Lama in 1972, and an Ecureuil/AStar AS350 B3 helicopter landed on Mt. Everest in 2005), the death zone for the human body without supplemental oxygen begins at 8 000 m. It would therefore be of benefit to have life-saving technology available to rescue people at such high altitudes. A high altitude rescue craft is needed, indeed. It's difficult to say whether that craft would be a kind of sophisticated manned balloon-drone hybrid or another VTOL craft, but it would be able to effectively save lives in remote high-mountain settings. Such potential Himalayan project should be international, to avoid territorial controversies.

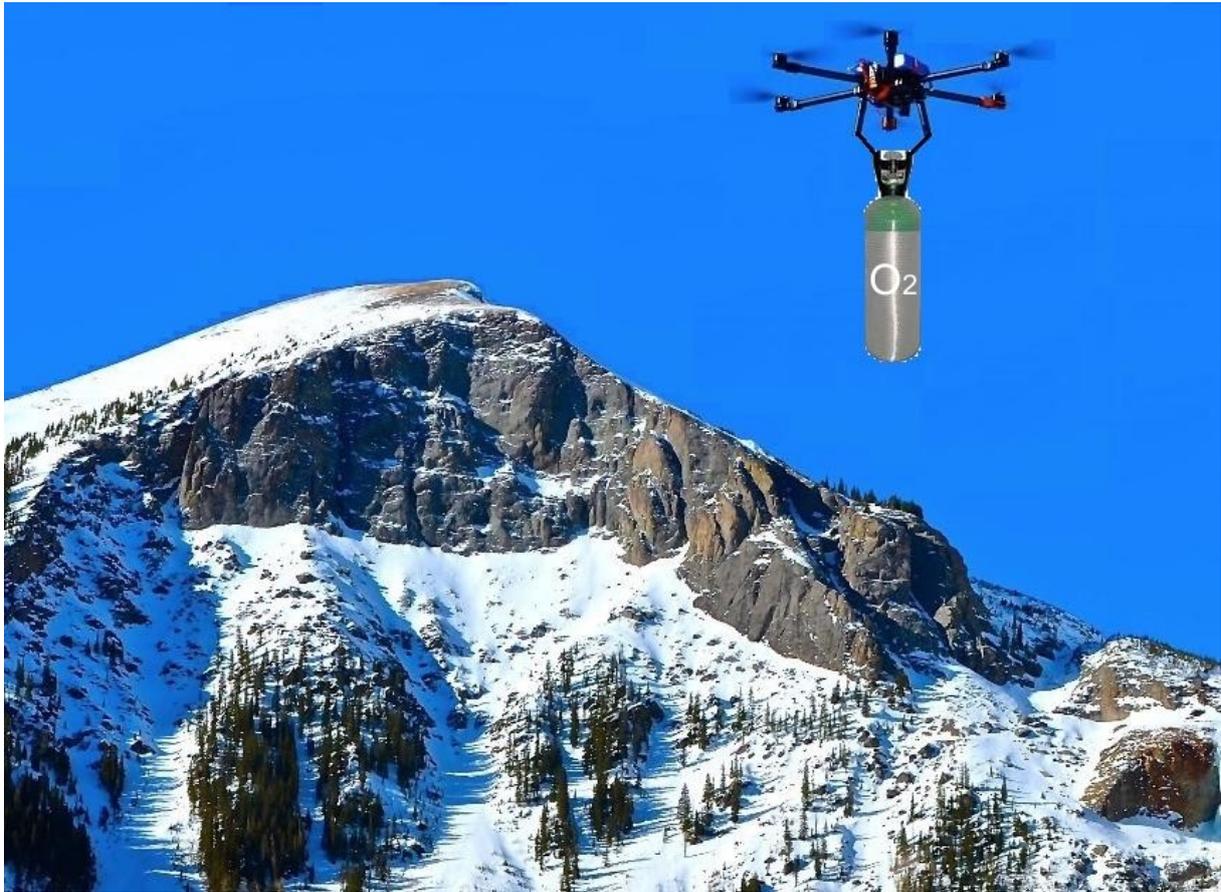


Figure 1. Editor-in-Chief's proposal of a high-altitude mountain rescue drone.



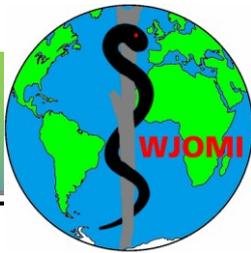
Figure 2. Medical cure-them-all pod as shown in the film Prometheus. Source: <http://www.perspex.co.uk/Perspex/media/Media/Inspiration%20Room%20640px%20x%20398px/Inplas/prometheus.jpg>



As to the hopes that were raised by nanotechnology – we are simply not there yet. The overwhelming scientific competition and race for academic titles do not contribute to cooperation between the different sectors in science. In my opinion medical nanotechnology needs another few hundred years to come and draw fully from its benefits. So, in order to make science-fiction a science, with tiny biorobots working inside our blood vessels to remove atherosclerotic plaques, travelling to neoplastic foci to neutralize them or numerous tiny armies to help augment our immune system in the fight against infectious agents – we will still need to wait a while for that. Medical pods to cure all conditions, such as those featured in the sci-fi movies like Elysium or Prometheus and many others will become a reality but probably not earlier than 400-500 years from now. This will also open a new chapter in humanity. With such sophisticated medical tools, we will be able to advance our space travels. When we will no longer be bothered by the incurables, we will need to look for other worlds to populate. This will mark the beginnings of the so called controversial “immortality studies” at the molecular level of the cell, not only when it comes to cell reparative mechanisms, apoptosis but also cell regeneration. Not aging will mean that initially we will be able to slow and extend our aging but later, with advanced studies, humans will live on indefinitely – this will be a huge advantage for space travels in the immense universe. People few millennia from now will probably consider us as cavemen.

But coming back to reality and the present tense, I recently stumbled upon an article by Megan Brooks in Medscape, quoting the last healthcare innovations [2]. I would like to make reference to them, here and now, with few brief comments:

1. Listed first by the author of the article is a mobile application to treat substance use disorders which include alcohol, cocaine, marijuana and stimulants, except for opioid dependence, all approved by the FDA. Good idea but probably will need time and bigger populations of patients to verify this technology, whether it's not just a temporary technological daze.
2. Direct-to-consumer (DTC) genetic testing which can detect potential diseases to come. Great idea but when used wisely. Otherwise a lot of patients with hypochondriasis will act as some celebrities did. Another drawback will be access to such data by employers and insurance companies. This will lead to human segregation and Apartheid repeated.
3. Acuity-adaptable care is ranked 3. It basically means that irrespective of the seriousness of the patient state, the hospital would keep a patient in the same room from admission to discharge (or possibly death), regardless of acuity level. Well, this will work well in developed countries with well financed healthcare sector but will probably fail in settings where not only specialist care is lacking but



the basic foundations of healthcare such as buildings and apparatus are missing.

4. Quoting on place 4 is the Abbot Labs' Confirm Rx, which is described as an implantable loop recorder cardiac monitor. Great idea and as mentioned in my Table 1 above, the science-fiction is becoming science.
5. Distraction-based virtual reality ranks number five. It will be useful in paediatric patients "to help children overcome or be distracted from the fear and pain caused by repeated injections and infusions needed for chronic conditions". Great idea.
6. "NeuroAD Therapy System (Neuronix Ltd) for Alzheimer's disease: "The technology purportedly delivers sustained cognitive improvement by combining noninvasive transcranial magnetic stimulation with computer-based cognitive training, added to existing pharmacologic therapy".
7. Very interesting novel technology comes at no. 7. Microneedle blood-collection device is described as a touch-activated phlebotomy FDA-approved device made by Seventh Sense Biosystems. The author says it extracts blood quickly and almost with no pain: "The single-use device, which is about the size of a golf ball, adheres to the patient's upper arm. A push of a button activates 30 microneedles and a small vacuum to collect 100 microliters of capillary blood over 2 to

3 minutes. An indicator signals that the collection is complete".

8. A great tool for neonatal imaging - the Embrace Neonatal MRI System (Aspect Imaging), that was approved by the FDA for point-of-care imaging in neonatal ICU. Excellent!
9. GammaTile cesium-131 (Cs-131) brachytherapy in neuro-oncology: "Cs-131 brachytherapy seeds purportedly deliver their radiation dose to the target tissue more quickly and more directly than either external-beam radiation therapy or other forms of brachytherapy that use different radioisotopes, potentially improving outcomes and reducing injury to adjacent healthy tissue". Superb!
10. Ranked as no. 10 are microhospitals "as a way to distribute care throughout a system's service region, to brand the health system, and to extend healthcare by positioning such hospitals in fast-growing suburban areas". Great idea, but again in well-off societies.

Innovations are part of our everyday life. In my lifespan alone, I was witness to many sci-fi described technologies which became reality:

1. The computer, e.g. my first one being an Atari 65XE with a cassette/tape player (sic!) to run programs. Nowadays we can't live or work without a computer;
2. Cellular/mobile/smartphones;
3. Internet;
4. Wi-Fi;
5. Digital cameras;



6. Electric vehicles;
7. Wireless charging;
8. Flat screen high-resolution TVs;
9. Smart-homes, -fridges,
and many, many more.

When it comes to medical technologies, when I was recently visiting China, I was shocked by the computerization in a big Beijing hospital, where patients could print their medical files and results by using ATM-like machines in the foyer.

My last year's favourite Polish technology which helps patients, was the one by a humble anaesthetist, Dr Krzysztof Grandys, from the Paediatric university hospital in Cracow who's using 3D- print technology to print prostheses for children – see more in the online article here [4].

I would not place that much worries in the artificial intelligence (AI) technologies, unless used by terrorists to destroy all of mankind. Humans tend to be control freaks and anything that would wane power from them to machines would be rather improbable, owing to our nature. We were always the dominant species and I personally don't see that will change in the years to come. So yes, AI will develop, but will always be closely controlled by humans.

I love to imagine what the future will be like medically, and such speculations usually make me happy, but of course one has to consider the major problems many health care systems face currently. Just to mention some, these are

problems with access to specialists, medical procedures and significant costs. There is no perfect healthcare system in the world, unfortunately.

But again, such problems should not stop people discovering new things, which will ultimately let us come close to curing mankind and probably start a new milestone in ethics – just as human cloning or brain transplant nowadays – it will be the search for immortality in the future.

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