

Keywords
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2000 Plus 100 The Future

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Bugs, Bodies, Bots and Doctors

Our goal is to look ahead into a future time using the best estimates of how technologies will evolve, unfold and prosper. Each article will look at a specific area and suggest a plausible future partly based on the potentials of today's state-of-the-art technologies. But, we'll also look for possible disruptive breakthroughs whose very nature makes them much harder to identify since they're supposedly, "unexpected". Futurists have often missed

the mark because they simply extrapolate present day technology only to be blindsided by the unexpected. Many science fiction writers came closer. But a look at the long history of technology and predictions will show that the "unexpected" was simply overlooked because the predictors, while thinking outside of the box, fail to get beyond the next box, and the next.... We hope to get past the right level of boxes, but not into the fantasy zone.

Today, we're hearing about the "new healthcare", but it's all about money and coverage, not technology. While the government ponders healthcare change, an extraordinary yet quiet medical revolution is underway. Let's step back for perspective. The medical practitioner, usually a physician, once visited the patient. The doctors, both rural and urban, often made house calls and carried their simple equipment. But as healthcare became more pervasive and complex, the dynamics shifted to achieve more efficiency and provide access to emerging non-portable machines. The patient traveled to the doctor and this is still the dominant model today. Not only will this change in the future, it's already happening using technology that's mature. The physician's home visit will resume using telematics. Later, robots will not only become the visiting physicians, they'll be the live-in caregivers.

Technology will dramatically change the health landscape over the next 150 years. Four key technologies will lead the way; (1) advanced telemedicine, (2) micro/nano systems, (3) robotics, and bio-modification. In just 50 years, micro-mechanical machines and nano-materials will play dominant roles, but so will telecommunications and software. There will be a steady convergence of technology and science as health is certified as the #1 priority. By 2075, we'll finally have long-envisioned internal mini-medibots roaming arterial highways and many will qualify as Nano-MEMS, or NEMS (MicroElectroMechanical Systems; N =

"Nano"). This will provide sensors, monitors, drug dispensers, electro-chemical-mechanical organs and brain/brawn boosters.

But by 2150, there will be a disruption and we'll phase out these device-centric artificial implants, internal medibots and other man-crafted contrivances. The next revolution will focus on nanobiology and molecular-level technology. DNA will be fully understood, but it will take extreme supercomputers and phenomenal software to disentangle these "blueprints". DNA, viewed as the software of life, will be the focal point for the "new health". Just as today's software can be updated and even "repaired", bad DNA will be routinely modified. But many will want to go far beyond repair and this will become a major ethics issue by the 22nd century. More disruptions! Forget doctor visits altogether – your caregiver will live at home.

Telemed

Apple has been successful, in part, by adopting long-proven, but underutilized technology, and applying it in clever and synergistic combinations as exemplified by the iPhone. Mature touch and motion sensing, for example, provides the input for 100's of useful and often amazing apps. That same mix & match off-the-shelf strategy is already being applied to healthcare and will accelerate during the next 50 years. Wireless and microsensor technology will be combined in clever ways for health monitoring, check-

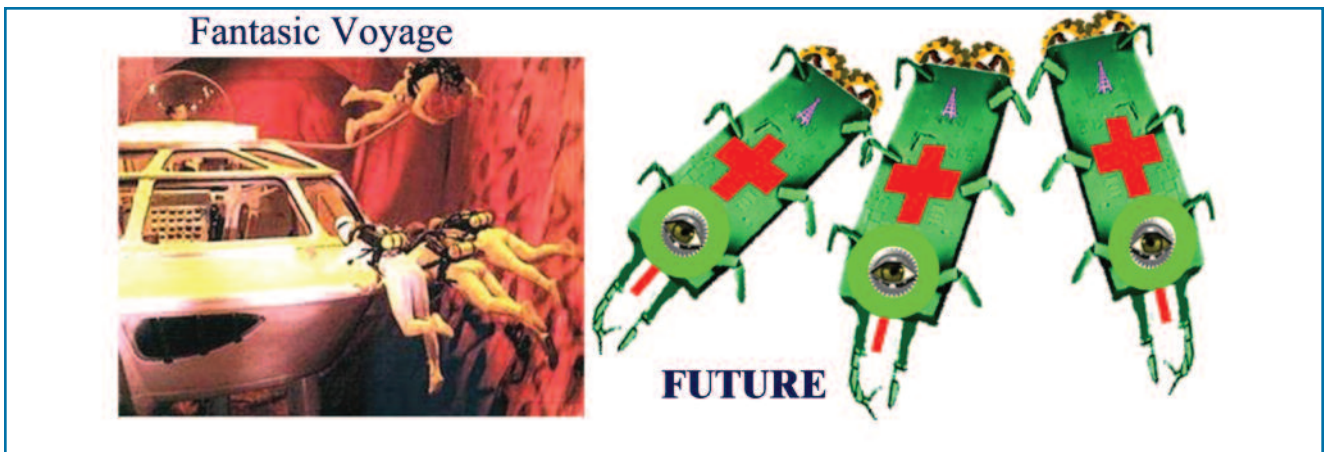


Figure 1.

ups, and more. Most of the fundamental technology is mature, but the implementation, building of an infrastructure, and overcoming fears, will require a concerted effort. Regulation, attitudes and lawsuits, not tech, are the bottlenecks.

Imagine an unconscious accident victim rushed to a small hospital in rural USA. Fortunately, the hospital can take a CAT scan, but who will read it at 2 am? On the other side of the planet (day-time), an experienced radiologist looks over the scan, makes a diagnosis, and sends back the report. This is starting to happen today, but it's only the beginning. More and more patient data will be sent by high-speed networks so that experts can serve a greater number and do it more efficiently. Fast wireless, finally immersing, will also be vital.

The first wave of patient-assisted telemedicine will be telepresence and remote treatment where monitors, both strap-on and implanted, will warn the patient and physician of imminent problems by cellphone using Bluetooth and Wi-Fi (and predecessors including WiMAX). In the future, the patient will play an ever-increasing role in obtaining the data that will be interpreted by the primary physician assisted by linked in specialists as required. Even today, IBM and others are working on interface standards for medical devices that will be used in the home and connected to computers and smart phones that are linked to caregivers and even researchers.

Invasion of the Body Patchers

Many high tech future advances will come from MEMS/NEMS and micro-photonics. Futurists have been waiting for the launch of the MEMS submarine-like medibots ever since technical writers began drawing the comparison between “Fantastic Voyage” and the attributes of MEMS [1].

iRobodocs

Japan, Korea, and to a lesser extent, the US, have been advancing personal robots. Korea made this a national initiative several years ago. With aging populations in most countries, especially the US and Japan, there will not be enough caregivers in the future. In fact, supply/demand is totally out of synch. Enter the robot! Personal robots are already here, but the level of so-


phistication will grow exponentially during the next 150 years. Healthcare in 2160 will no longer be centered on the human physician except when extreme specialists are needed. The personal robot will have family status and marriage laws will become an issue.

Ultimate Medicine – Super Designer Genes

We've been talking about modifying life forms even before Dolly the cloned sheep, and this will one of the final frontiers of medicine. While we will love our add-on and add-in medi-gadgets, they're unnatural, alien to the body, and just a phase. Even today, the DNA abnormalities for several diseases have been mapped. DNA repair will be well advanced in the next 100 years and replacement organs and other parts, like joints, will be available from body farms. But the extraordinary advancement in DNA manipulation over the next 150 years will become a two-edged sword. We won't remain satisfied with just “healthy and normal”. Individuals will want to be best in class and countries will want a super race – and it will be obtainable. Unfortunately, as Asimov observed, “...science gathers knowledge faster than society gathers wisdom”.

References

[1] Gilleo, K., **MEMS/MOEM Packaging: Concepts, designs, materials and processes**, McGraw-Hill, New York, NY June 2005.

 **Ken Gilleo, PhD.**, has vast experience in many high-technology manufacturing areas plus he has hundreds of patents. Ken has written many articles and technical papers as well as several books. More importantly, Ken is a true visionary who delights in sharing insights on the best technologies of today and future possibilities. He is the principal of ET Trends LLC in Warwick, RI. He can be reached at Ken@ETTrends.com.