THE MYOPIC VISION OF AN ENDLESS HORIZON

Dag von Lubitz, Chairman and Chief Scientist, MedSMART, Inc., Ann Arbor, USA

During the past 50 years, biomedicine experienced the period of the most explosive growth in its history. Increased understanding of pathophysiology of disease combined with the improved methods of medicinal chemistry resulted in new potent drugs. Inventions made during the Second World War formed the backbone of hitherto unprecedented diagnostic techniques that, accompanied by the exponential growth of computer and information technologies, affected virtually every form of medical research and clinical practice [1,2]. Finally, the last decade of the 20th century witnessed the entry of modern genetics, molecular biology, and nanotechnology as the essential tools needed to unravel the mysteries of some of the most debilitating diseases that affected the humanity throughout its recorded history. Yet, despite the boundless optimism of the medical world that this unstoppable progress would ultimately result in the eradication of illness, expansion of longevity, and vast improvement of the quality of life, shadows began to emerge. Beginning in mid-70ties, the rate of HIV infection started to increase until, in the following decade it reached proportions of a pandemic, and the acronym "AIDS" became a household word. Outbreaks of previously extremely rare diseases such as ebola became progressively more noticeable, new antibiotic resistant strains of bacteria emerged, and entirely new killers such as SARS exploded upon the unsuspecting world.

It should not come as a surprise that the majority of the new diseases that today have an impact on the entire globe emerged from the less developed regions of the world where continuously faltering economies arrested introduction of modern healthcare programs. Consequently, the rapidly widening medical gap between the affluent Western world and the impoverished rest of the globe produced "incubation pools" for medical problems of potentially world-wide impact.. Even more significantly, trends in the development of advanced technologies (information technology in particular) whose judicious application could positively affect and improve the pattern of global health, became more attuned to the social and medico-economic needs of the Western society rather than those of the entire population of the world [3]. As a result, the impoverished segments of global population have hardly any access to even the most essential forms of medical care, while the richest countries of the world spend vast sums of money to develop techniques combating "disorders of civilization" that, in some cases at least (e.g., stroke, hypertension, or diabetes,) can be prevented by simple modifications of eating habits and a modicum of exercise [3].

Presently, it is estimated that by the year 2004 approximately 1 billion people will be connected either to the Internet or to some form of a mobile telecommunications network [4]. Such connectivity is an important element in the development of the society considering the fact that "Information and Communication Technologies (ICT) represent a good opportunity to increase the quality of life of the citizen" [5]. One of the critical aspects of such improved quality of life is high quality healthcare. The electronic world opened the door to the entirely new concept of "e-health" of which telemedicine, i.e., electronic delivery and use of medical expertise at the point of need, became one of the major constituents. Originally viewed as an enabling method, telemedicine found its applications within the entire spectrum of healthcare delivery, starting from simple consultations and ending on complex issues of home healthcare or "dehospitalization" of the chronically ill [5]. Yet, the experimental applications of the concept notwithstanding, today's telemedicine is still relatively far away from attaining its true, global potential, its uses are frequently mundane, and complicated by disparate regulations, standards, and differences or even incompatibility among the telecommunication platforms used by individual systems [6]. None of these issues constitutes a truly significant limitation of

telemedicine. Instead, it is its own operational medium – connectivity to telecommunication platforms. A significant part of telemedicine operations is conducted via the Internet [7]. However, in the world of over six billion people only one among six prospective users of telemedicine or other forms of e-health can actually benefit from this form of healthcare [3]. Moreover, the majority of the beneficiaries are located in the Western world, i.e., that part of the global society that is already characterized by highly advanced (even if often unnecessarily expensive – e.g., USA) healthcare systems.

Combination of the robotic surgical systems with modern, high-speed information and telecommunication systems constitutes the foundation of even more spectacular, even if still sporadic, form of medical help – telesurgery [8]. The technique allows projection of continuously scarcest medical resource – expertise – to potentially even the most remote part of the globe, and permits the execution of even very intricate surgical intervention without the need for the surgeon to leave the office. The current technological complexity of such procedure notwithstanding, the essential issue affecting telesurgery is its large-scale usefulness. It is difficult to imagine remote or rural hospitals of the Western world, or hospitals in Less Developed Countries (LDCs) gaining rapid access to presently very expensive robotic devices at the time when advanced desk-top computers are still a rare and eagerly sought commodity at such places [3]. Even if the price of the required technology will undoubtedly decrease, it appears more likely that the transport of the patient to a competent surgical facility may still remain the cheapest and the most effective option. Even more importantly, the considerable funds required to maintain remote telesurgical systems and their associated advanced telecommunication platforms may possibly be better spent on adequate training of the local surgeons. The problem is best exemplified by the comment of an African physician following the author's lecture on medical technology at Healthcom 2002 conference in Atlanta [9]: "We really don't need gadgets. We desperately need training!"

There is no doubt that advanced technology may have a very significant impact on the way we train future generations of healthcare providers. Virtual reality training devices ranging from procedure trainers to fully immersive systems [10,11,12] have proven their applicability in critical studies [13,14]. The same is true of highly complex simulation systems [15,16]. Very significantly, advanced telecommunications allow projection of VR and other simulation environments over essentially unlimited distances [12,17]. This is an important element considering the fact that at some of the medical education sites of the Third World adequate access to modern medical textbooks and professional literature may not exist. The M(edical)-ASP concept deriving from that of the Application Software Provider becomes then a viable option at these locations, particularly that effective simulation-based training by remote experts can be offered using some of the simplest carriers (POTS) [18]. Yet, the issue of cost is as persistent as ever. Who will pay for the cost of such training? Who will pay for the necessary (even if simple) technology at the remote sites and its maintenance? Who will pay for the central training facilities? Once again, while theoretically suitable for countries that cannot afford sophisticated technology-based training facilities, distance-enabled medical education and training appear to be the invention aimed not at its most needy audiences – healthcare providers in LDCs. Instead, the benefits go those who need it least, i.e., the countries with well-developed technical and medical infrastructures, whose wealth permits routine use of the most modern technologies not to build the foundations of a modern medical professional but to improve the quality of what has been already developed by the traditional methods of training.

The preceding arguments paint a highly gloomy picture of technology in the context of global medicine. But is it really so? One must remember that most of the achievements mentioned above are the result of the past decade. It is a nascent world, and it is a world that, in similarity to the rest of medicine, is at the explosive stage of growth. Not a long time ago, the concept of

multidisciplinary approaches in medicine was unheard of or at least unwelcome. Today, patients are managed by medical teams which only very recently have been augmented by engineers, information technology- and telecommunications specialists [19]. The past cleft separating laboratories from clinical units narrows very rapidly, and the transition from the experiment to the bedside is forever shorter and shorter. It does not take a great stretch of imagination to envisage remotely operated nanontechnology-based diagnostic, surgical, or targeted drug delivery systems introduced as a simple IV injection into the patient located at one site, yet monitored, controlled, and manipulated from maybe even thousands of kilometers away [19]. We are at the place in medical history when, for the first time, the horizon of new possibilities is entirely limitless. But it is the myopic view of the realities of the medical world of today, with its inequalities and disparities that is necessary to convert "gadgetry" into the tools of global medicine. Tools that will allow us to explore fully the "good opportunity to increase the quality of life of the citizen" that modern technology offers every citizen of the world 19]

REFERENCES

1. Porter R., (Ed.). (1996). The Cambridge Illustrated History of medicine, Cambridge, Cambridge University Press
2. Lock S, Last JM, Dunea G, (Eds.). (2001). The Oxford Illustrated Companion to Medicine, Oxford, Oxford University Press
3. Von Lubitz DKJE, Levine H, Wolf E. (2002). The Goose, the Gander, or the Strasbourg Paté for All: Medical Education, World, and the Internet. In W, Chin, F. Poatricelli, V. Milutinovoc (Eds.). Electronic Business and Education: recent Advances in Internet Infrastructures (pp. 189 – 210), Boston, Kluwer Academic Publishers
4. Koch R., Yanovsky G, 2002, Evolution and Convergence in Telecommunications, ICTP Lecture Notes Vol. 11 (S Radicella, D. Grilli, EDS), Abdus Salam ICTP (Trieste), 7-184
5. Beltrame F, 2002, New perspectives in the health area: e-health, In Telemedicine in Care Delivery: Technology and Application (V Macellari, R. Bedini, EDS), Natl. Institute of Health, (Rome), 23-24
6. Von Lubitz DKJE, 2002, Telemedicine or medical telepresence, In Telemedicine in Care Delivery: Technology and Application (V Macellari, R. Bedini, EDS), Natl. Institute of Health, (Rome), 17-20
7. Coiera E, 1997, Guide to Medical Informatics, the Internet and Telemedicine, Oxford University Press (Oxford), pp. 1- 408
8. Marescaux J, Rubino F, 2003, Telesurgery, telementoring, virtual surgery, and telerobotics. Curr Urol Rep. 4, 109-13
9. Von Lubitz DKJE, Carrasco B, Gabrielli F, Levine H, Patricelli F, Poirier C, 2001, Global Simulation-based Medical Training - New Solutions to Old Problems, In Proceedings 3rd Intl. Healthcom Conference (F. Patricelli, P. Ray EDS), L'Aquila, June 2001
10. Shapiro SA, Silverberg M, 1999, Virtual reality Based Medical Technologies, AdvanceTech Monitor, Woburn, MA (http://www.advancetechmonitor.com)
11. Graschew G, Roelofs TA, Rakowsky S, Schlag PM, 2002, Interactive videocommunication networks over satellite in the operating room of the future – OP 2000, In Telemedicine in Care Delivery: Technology and Application (V Macellari, R. Bedini, EDS), Natl. Institute of Health, (Rome), 49-54
12. Von Lubitz DKJE, Pletcher T, Treloar D, Wilkerson W, Wolf E, 2000, Immersive virtual reality platform for medical training: a "killer application", in Medicine Meets Virtual Reality 2000 ((ed. Williams, J., et al), IOS Press, Amesterdam
13. Gallagher AG, Satava RM, 2002, Virtual reality as a metric for the assessment of laparoscopic skills: Learning curves and reliability measures, Surg.Endosc. 16, 1746-52
14. von Lubitz DKJE, Carrasco B, Gabbrielli F, Levine H, Levine R, Ludwig T, Poirier C, 2003, Transatlantic medical education: preliminary data on distance-based high fidelity human patient simulation training. Medicine Meets Virtual Reality 2003 (J. Westwood, ED), IOS Press (Amsterdam), 379-85

15. Lary MJ, Pletcher T, von Lubitz, DKJE, 2003, Distance-based mass medical readiness training for prehospital providers, SSGRR Internet Conference, L'Aquila, Italy http://www.ssgrr.it/en/ssgrr2003s/panel.htm
16. Holcomb JB, Dumire RD, Crommett JW, Stamateris CE, Fagert MA, Cleveland JA, Dorlac GR, Dorlac WC, Bonar JP, Hira K, Aoki N, Mattox KL, 2002, Evaluation of trauma team performance using an advanced human patient simulator for resuscitation training, J. Trauma 52, 1078-85
17. Murray WB, Foster PA, Crisis resource management among strangers: principles of organizing a multidisciplinary group for crisis resource management, J. Clin. Anest. 12, 633-8
18. von Lubitz DKJE, Montgomery J, Russell W, 2000, Just in time training: emergency medicine training aboard a ship. Navy Medicine 3-4, 24-28
19. von Lubitz DKJE, Montgomery J, Russell W, 2000, Just in time training: emergency medicine training aboard a ship. Navy Medicine 3-4, 24-28