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Rethinking Prevention in the Biomedical Era

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In the Greek world Hygeia, the goddess of health and hygiene, was custodian of prevention. She was the daughter of Asclepius, who was said to have learned medical arts from the centaur Chiron, or directly from his father Apollo. Therefore, already at the dawn of medicine the art of preventing disease was in focus.

Of course, much has changed in terms of our knowledge, technologies, diagnostic skills and scientific investigation. Yet it seems that this ancient bond between the medicine for healing and medicine for prevention should not be broken, but rather renewed and recreated in light of the medical culture of our time.

The first question we should ask is, does it still make sense today to talk about prevention in a world that promises personalized medicine, and regeneration, with a glimpse of new hope for understanding and healing?

Why direct research towards preventive procedures and interventions when smart drugs or "organic medicines" may allow complete remission of infectious diseases or non-communicable diseases?

Many believe research should prioritize such issues and we should support an ancient seemingly anachronistic approach, the one of quarantine, the investigation of routes of infection and water remediation. Yet, as rightly argued by David Weatherall et al.[1] "As we move into the new millennium it is becoming increasingly clear that the biomedical sciences are entering the most exciting phase of their development. Paradoxically, medical practice is also passing through a phase of increasing uncertainty, in both industrial and developing countries. Industrial countries have not been able to solve the problem of the spiraling costs of health care resulting from technological development, public expectations, and – in particular – the rapidly increasing size of their elderly populations. The people of many developing countries are still living in dire poverty with dysfunctional health care systems and extremely limited access to basic medical care."

Rightly, these authors speak of two important megatrends which today we are called to face: the first is demographic transition, also epidemiologic and the still unfinished model of care transition. The primary consequence of the first is certainly the growth in life expectancy and the consequent increase in aging of all Western populations but, attention, also present in developing countries.

Today individuals over 60 years of age comprise over 800 million people worldwide and it is estimated that by 2050 this figure will triple. In developing countries alone it is expected that by 2050 there will be 1.6 billion elderly individuals. The demographic transition necessarily causes a quick change in the pattern of diseases, framed by the so-called epidemiological transition, with a dramatic shift towards non-communicable diseases and the inevitable string of complications that characterize diseases such as diabetes, emphysema, arthritis, syndrome X and more.

Therefore a foremost and decisive element concerns the significant change in populations, in age and in diseases which modern medicine faces today. Mainly this concerns the emergence of a phenomenon that can be defined as "frailty".

Prevention of this condition is essentially based on secondary or tertiary approaches but it is important because it implies significant consequences including the overuse of medical services, susceptibility to the phenomena of global warming, the so-called heat waves, dependency and disabilities. Frailty is very common among elderly, with a prevalence rate ranging from 4 to 59%.[2] It can be defined as "a clinical state of increased vulnerability to poor resolution of homoeostasis after a stressor event which increases the risk of adverse outcomes, including falls, delirium, and disability… this geriatric condition represents a huge potential public health issue at both patient and societal levels because of its multiple clinical, societal consequences and its dynamic nature."[3]

Some evidence on the real possibility of prevention of frailty accumulated over time include parameters such as physical activity,[4] nutritional supplementation both caloric[5] and proteic,[6] supplementation of vitamin D[7] and the control and reduction of drug overload,[8] often linked to the presence of co-morbidities.

The second megatrend concerns economic aspects. In the Western world we face rising costs of care and associated technological aspects. In developing countries we face restrictions for accessing care due to lack of resources. Essentially medical care today faces significant problems of sustainability.

A recent overview[9] shows projected costs for 2014-2018 based on an annual growth of 4.9% for the US and 2.6% for Western Europe, 4.6% for Latin America, and up to 12.5% in China and 15.2% in India. Aging, shortage of skilled human resources, and increased access to services, drugs and technologies will be the main drivers of this growth. I think it is necessary to ask ourselves whether this is sustainable and does not impel us to a shift towards a more assertive approach based on the prevention and control of the major determinants of health.

I might add a third megatrend that is involved in this reflection: that of the relationship between the environment and health and the consequent commitment that will be requested. A key message launched by the European Environmental Agency in 2015[10] is as follows: "Around 25% of the burden of disease and deaths is attributable to environmental causes. Urban air pollution is set to become the main environmental cause of premature mortality worldwide in 2050."

I have failed to mention many other environmental concerns: water safety, the consequences of climate change, nutrition, and more. What is important to emphasize it is that in a world increasingly populated by the elderly, dominated by non-communicable diseases and characterized by a poor relationship with the environment, life sciences must broaden its vision and renew its relationship with prevention, extending horizons, techniques, and interventions.

You cannot be thinking only of cure when the causes of disease are multiplying. It is obvious here that the concept of prevention expands well beyond the field of assistance. Should we worry about health even when we design factories, housing, transportation, agricultural production? In this sense acting on sustainability will lead to more effective control of the determinants of health: nutrition, physical activity, networks of social relations, education and income, to name a few.

This discussion should not exclude the issue of lifestyles, their impact and control measures. In this regard I quote an interesting document from the European Union:[11] "A significant amount of premature mortality is the result of lifestyle practices such as smoking, poor diet and lack of physical activity. According to the WHO, deaths from chronic diseases, which are significantly associated with lifestyle risk factors, accounted for 60% of all deaths worldwide: 20% in high income countries and 80% in low and middle income countries in 2005 (WHO 2005). To take another example, in the United States (US), deaths from smoking, inactive lifestyle, poor diet and misuse of alcohol have been estimated to be responsible for 900,000 deaths annually, nearly 40% of the total yearly mortality."[12]

While addressing the question of the usefulness of prevention we also outlined the features of his renovation: we need to also prevent in the aged and already sick people, in an environment made unhealthy, in self-injurious behaviors and lifestyles. Maybe we also need to revisit the relationship between curative medicine and prevention medicine. The latter (prevention) is not always a daughter – as in the case of Hygeia – of the first (treatment and cure) and its knowledge.

A quite striking example comes from our fight against the HIV/AIDS pandemic: after decades spent on research of prevention through condoms, changing lifestyles modifications and male circumcision, we realized that treatment with antiretrovirals could be a decisive weapon in the control of infection. Having undergone therapy, over 15 million people allowed the reversal of the trend for new cases of disease, and of course opening new opportunities for survival among the infected. Treatment for prevention is the new mantra adopted by scholars in this field.

We must remember that although infectious diseases appear to regress they are not defeated: let us think of the great pandemics, like the one already mentioned, HIV/AIDS, or TB or malaria. Furthermore, the formidable changes in the way we produce, change the planet and inhabit it has led to the rupture of secular segregations and contact with new and dangerous viral or bacterial agents. I quote here only the example of Ebola and its carriers, bats. Scientists estimate that between 1940 and 2004, 335 new infectious diseases appeared in humans. There are believed to be about 320,000 viruses in the world that infect mammals. It is likely that among them the next big one is hiding, the agent capable of a new global pandemic. We need close monitoring in areas where rapidly expanding human populations meet natural environments rich in biodiversity generating contacts with agents that so far have been segregated.

In conclusion, prevention can and should have many parents: if it is true, as claimed by the MIT that the third scientific revolution will be realized with the convergence of life sciences, physics and engineering,[13] this adds further to the wide prevention concept we have outlined. It ranges from modeling and simulation to the search for new biomarkers, without neglecting the epidemiology, health education, and the science of community health promotion. In short, biomedicine can be thought of within the aspect of prevention.

Even so, we have to tell ourselves, prevention has recorded numerous failures. Consider, for example, the problem of controlling obesity and its complications. Over the past 30 years obesity rates have more than doubled in adults and more than tripled in children with health costs rising rapidly. The consequences of diseases such as diabetes, vascular accidents, osteoarthritis and some cancers are obviously very negative. Yet even today we do not have any really effective means of preventing and controlling this pandemic with impressive dimensions.

This journal which comes with the number 0, wants to first and foremost help renovate the science of prevention, creating convergence between different areas of knowledge, while collecting and valuing experience and acquisitions in various fields. Secondly, this journal proposes to promote and encourage research aimed at integrating curative medicine and prevention medicine making them two poles with the same approach. The challenge of implementing successful prevention strategies seems decisive for our future and well being.

References

1. Chapter 5 Science and Technology for Disease Control: Past, Present, and Future
   David Weatherall, Brian Greenwood, Heng Leng Chee, and Prawase Wasi. In Disease Control Priorities in Developing Countries. 2nd edition. World Bank; 2006.
2. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC: Prevalence of frailty in community-dwelling older persons: a systematic review.
   J Am Geriatr Soc 2012, 60:1487-92
3. Fanny Buckinx, Yves Rolland, Jean-Yves Reginster, Céline Ricour, Jean Petermans and Olivier Bruyère: Burden of frailty in the elderly population: perspectives for a public health challenge. Archives of Public Health 2015, 73:19
4. De Vries NM, van Ravensberg CD, Hobbelen JS, Olde Rikkert MG, Staal JB, Nijhuis-van der Sanden MW: Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multi-morbidity: a meta-analysis.
   Ageing Res Rev 2012, 11:136-49.
5. Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, et al.: Frailty consensus: a call to action.
   J Am Med Dir Assoc 2013, 14:392-7
6. Morley JE: Do frail older persons need more protein?
   J Am Med Dir Assoc 2012, 13:667-8.
7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K: Frailty in elderly people.
   Lancet 2013, 381:752-62
8. Kojima G, Bell C, Tamura B, Inaba M, Lubimir K, Blanchette PL, et al.: Reducing cost by reducing polypharmacy: the polypharmacy outcomes project.
   J Am Med Dir Assoc 2012, 13:818.e811-815.
9. 2015 Global health care outlook, Common goals, competing priorities. Deloitte. http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/gx-lshc-2015-health-care-outlook-global.pdf
10. SOER 2015 — The European environment — state and outlook 2015
11. Is prevention better than cure? A review of the evidence By Divya Srivastava European Commission
    Directorate-General "Employment, Social Affairs and Equal Opportunities"
    Unit E1 – Social and Demographic Analysis
    Manuscript completed in May 2008
12. Mokdad, Marks et al. 2005
13. Philip A. Sharp et al. The Third Revolution:The Convergence of the Life Sciences, Physical Sciences, and Engineering.MIT, 2011