

An OMLT (Operational Monitoring and Liaison Team) physician providing medical aid in a village in Afghanistan's Logar Valley



Health



KEY MESSAGES

Under the pressure of ethnic and societal changes and the new health issues with an international dimension, health stands out as a priority for the coming decades. The awareness of the political, strategic, and security implications of health matters and the globalisation of health hazards should stimulate greater mobilisation.

The evolution of certain parameters affecting health (generalised ageing of the population, increasing urbanisation, risk of new pandemics, technological breakthroughs, etc.) has a strong impact on the governance aspect of the health system (regional or international) and on its organisational aspect, but the issues are also scientific, societal, ethical, economic, and industrial.

Because, by their nature, health policies involve the medium and long term, several paradigm shifts can be anticipated in the time frame of the next 30 years:

- A technical revolution in medicine, which will become more personalised, predictive, pre-emptive and participative, will consecrate significant progress in diagnostics and therapeutic techniques in particular;
- An economic and financial step change in the health system model, particularly in the pharmaceutical industry;
- The appearance of an epidemiological transition involving a new preventive approach;
- The emergence of a 'health democracy' driven by the development of ethical questioning, risk aversion, and the replacement of the preventive approach with a precautionary approach.

Progress in terms of research, technological developments, and the mobilisation of the international community concerning the major health issues could improve the health situation of developing countries by curbing certain infectious diseases (development of new vaccines, antibiotics). The development of new technologies, however, runs a risk of widening the gap between northern and southern countries, whilst access to health care will remain a major issue.

1 Health care supply and demand determined by demographic changes

The main demographic changes—natural growth, ageing of the population, and male/female imbalance—are bound to have major repercussions on the supply and demand for health care.

1.1 - Demographic imbalances placing pressure on the demand for health care

The world's population will grow at a rate of roughly 1% per year until 2030. This growth, which will occur primarily in urban areas, will lead to an increase in underprivileged populations that are highly exposed to health hazards and thus exacerbate the problem of access to health care.

Whilst the number of persons over 80 should double on a worldwide scale by 2040 and treble in developing countries, this ageing of the population will lead to a rise in the cost of dependence, including in developed countries, which will experience an increase in disability-free life expectancy.

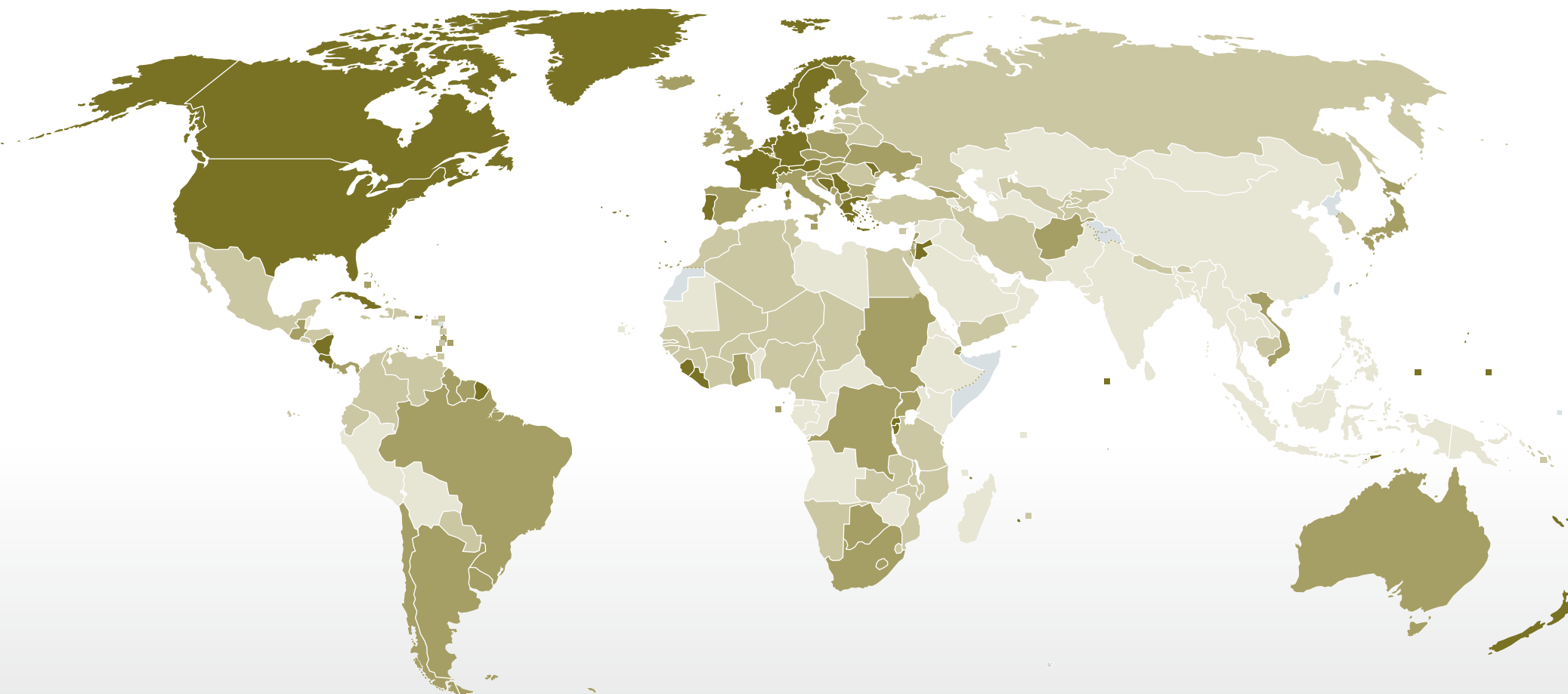
The increase in ageing-related health expenditure should be approximately three GDP points in the developed countries over the next 20 years, compared to one point for emerging countries. However, experience (four-point increase in the last 40 years) suggests that it should be possible to absorb these additional costs. Besides, this increase will be largely due to medical advances rather than ageing itself.

In France, the number of persons over 80 should double in the next 30 years to top 6 million, of whom 15% will be dependent. The impact of ageing on health spending is estimated at 0.5 to 2.5% of GDP between now and 2050¹, according to whether the health of senior citizens improves spontaneously or whether, on the contrary, health care for the elderly is intensified. Despite its moderate impact on health expenditure, the ageing of the population, combined with technological developments, could increase the overall cost of covering old age, sickness and dependency risks, at a time when the room for manoeuvre is already restricted by the level of social debt.

These potential difficulties in financing the social protection system could lead to a reduction of benefits and weaken inter-generational solidarity, which would affect the durability of the system.

Privatisation of health care (introduction of market mechanisms) could increase in an effort to limit spending. This trend, already operating in certain countries (USA and UK in particular) could become more widespread, both in developed countries (EU) and in certain emerging or developing countries (Sub-Saharan Africa, etc.), thus amplifying inequalities on a national level.

1- 'Les dépenses de santé en France : les déterminants et les impacts du vieillissement à l'horizon 2050', Direction générale du trésor et de la politique économique – *Les cahiers de la DGTPE*, No. 11, July 2009. 'La démographie médicale à l'horizon 2030 : de nouvelles projections nationales et régionales détaillées', DREES – *Dossiers solidarité et santé* No. 12, 2009.



Total health expenditure is the sum of public and private health expenditure. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.

Source: World Health Organisation, World Health Report and updates; OECD, OECD country reports; World Bank, poverty assessments and country and sector studies.

Source: World Bank, <http://data.worldbank.org>

Map Department of Sciences Po, 2011

1.2 - The development of 'medical demographics': an increasingly unequal health care offer

In 2040, access to health care should still be very unequal, not only nationally, between privileged and underprivileged circles, but also on a worldwide level between developed and developing countries. The development of 'medical demographics' will only amplify this trend.

The 60 million or so health care workers[□] on the planet are very unequally distributed from a geographical standpoint: although Sub-Saharan Africa accounts for 11% of the world's population and bears 24% of the morbidity load[□], it has only 3% of the health care workers on the planet. Conversely, the Americas employ more than one-third of the world's health care personnel, with a morbidity load of roughly 10%. This trend could grow over the next 30 years in view of the disproportionately high number of health professionals amongst the candidates for emigration from poor countries to developed countries.

Nevertheless, even though these migratory flows of health care personnel are rising sharply, they will not be able to solve the problems of the territorial medical demographic deficit and inequality, which should also affect certain developed countries (UK, USA, etc.). Thus, in France, the number of doctors should drop by almost 10% in the next 10 years, but begin to rise again in 2020. This trend should be accompanied by an increasing proportion of female medical personnel, an increase in salaried or part-time activities, and an increasing shortage of facilities in areas with a low medical density. The paramedical professions should not face any particular shortage in the next 30 years. It is not so much the number of practising medical professionals that will cause a problem in the years to come, but how they are distributed over the French territory.

The emergence of new technologies should herald the arrival of new players in the health care field, with the creation of boundary professions (between medicine and new technologies) and/or mixed professions. The sharing of skills could gain a new impetus with the creation of 'intermediary' health care professions.



2 Major pathologies

In the next 30 years, the worldwide morbidity load will evolve, with non-communicable diseases and certain chronic pathological conditions (heart disease, stroke, etc.) overtaking infectious diseases (diarrhoea, HIV, tuberculosis, neonatal infections, malaria, etc.).

2.1 - Illnesses related to the ageing of the population

Cancer will remain the primary cause of mortality, accounting for 8 million deaths per year worldwide, or 13% of mortality. Resulting mainly from external factors (exposure related to lifestyles, air pollutants, water, food), the increase in number of cancers will be largely dependent on the prevention policies implemented by public authorities. Although the World Health Organisation (WHO) forecasts that the number of persons affected could increase by 50% between now and 2020 because of ageing, smoking, or diet, screening, prevention and treatment campaigns could help to prevent one third of cancers, cure another third, and provide palliative care to the remaining third.

The ageing of the population should make degenerative illnesses such as Alzheimer's and Parkinson's diseases a major epidemiological issue and, in developed countries, should constitute the main cause of dependence and admission to care facilities for the elderly. The frequency of dementia cases should almost double every 20 years, to reach almost 66 million cases worldwide¹ in 2030, and more than 115 million towards the middle of the century.

One of the key factors in the development of Alzheimer's disease will lie in the discovery and confirmation of biomarkers¹, which will enable earlier diagnosis and better predictability of the effectiveness of many treatments under development.

2.2 - Illnesses related to urbanisation, stress, and sedentary lifestyle

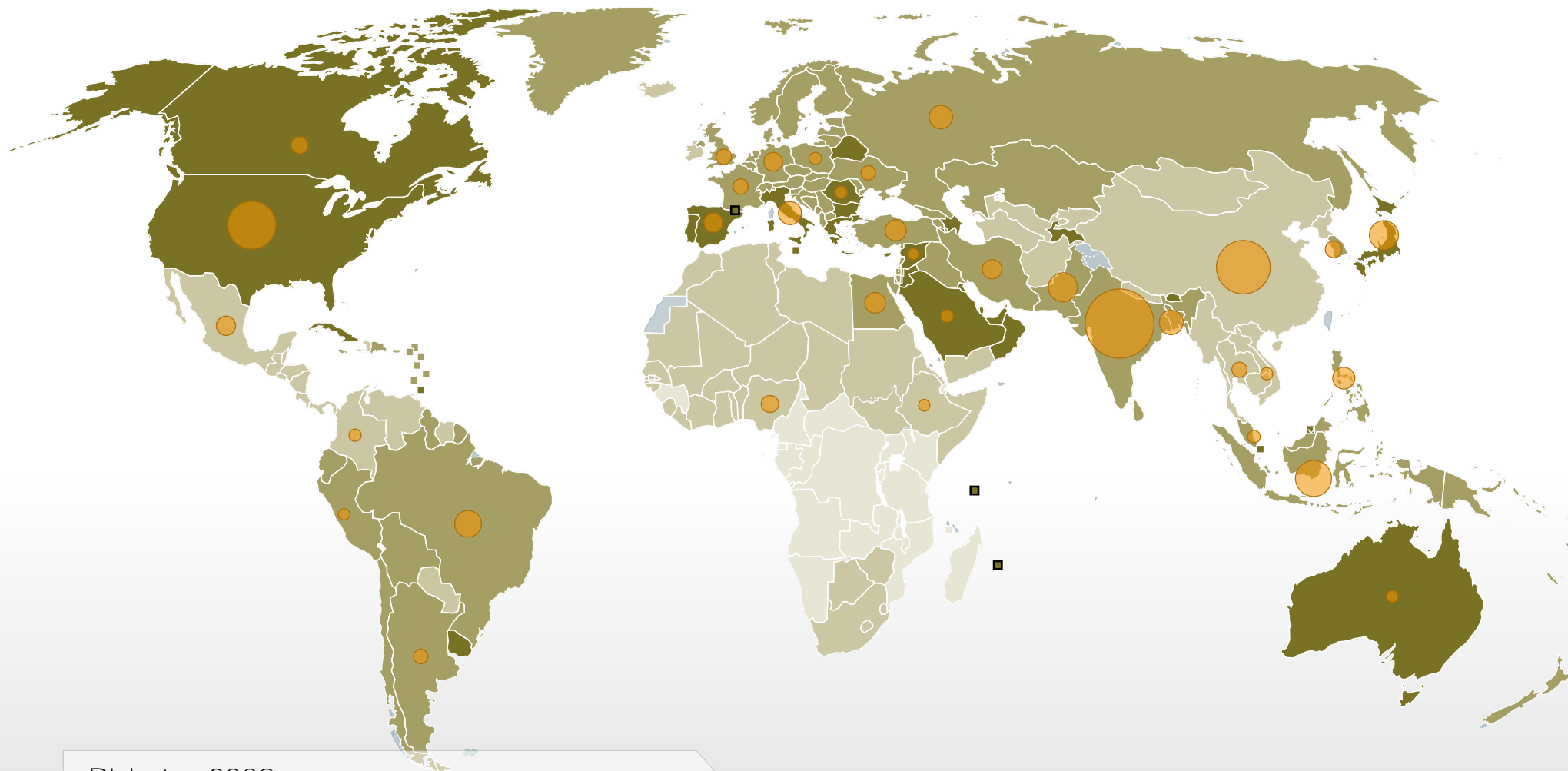
Although cardiovascular mortality is continuing to diminish, nearly 24 million persons are expected to die of cardiovascular disease between now and 2030, and this disease will remain the second cause of death in the world.

The highest rate of increase is expected to affect the eastern Mediterranean region, and mortality is expected to be highest in Southeast Asia.

Called 'humanity's leading non-infectious epidemic', by the WHO, obesity will constitute one of the most serious public health problems of the 21st century, affecting both developed and developing countries, although for different reasons (overall excess food consumption in developed countries, and nutritional imbalance or *maldevelopment* in developing countries). Obesity is increasing considerably in emerging Asian countries, and its frequency has trebled in many European countries since the 1980s, with an alarming rate of increase in the number of persons affected—especially children. Obesity is thus the cause of 2 to 8% of health care spending, and more than 10% of deaths in European countries. This trend should accelerate, with the associated consequences in terms of cancer and cardiovascular disease and, above all, more cases of diabetes.

Whereas 220 million persons are affected by diabetes worldwide, nearly 80% of the deaths it causes occur in low- or medium-income countries. The number of patients is expected to double between now and 2030, particularly in countries where the population is still rising quickly, such as India.

1- 'Alzheimer's disease international', *World Alzheimer report 2009*.



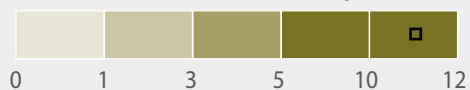
Diabetes 2008

Data calculated for 2007 based on figures from 2000 and projections for 2030

Million diabetics



Diabetes (prevalence as a percentage of adults)



No information

■ Samoa

■ Kiribati, Marshall Islands, Solomon, Tonga, Tuvalu, Vanuatu

■ Cook Islands, Fiji, Micronesia, Palau

Source: WHO Diabetes Programme, www.who.org

Map Department of Sciences Po, 2011

2.3 - Endemic¹ and emerging² communicable illnesses

Nearly 30 years after the AIDS epidemic began, progress is being made on stemming the spread of HIV. The number of new infections has fallen by almost 20% in the last 10 years and the number of deaths has fallen thanks to wider access to antiretroviral treatment in recent years.

Nevertheless, more than 33 million people in the world are infected with HIV, of whom 95% live in developing countries. 1.8 million people died of HIV in 2009. Despite the reduction in the number of new infections, the number of persons living with the virus is on the rise because of the reduced mortality rate—a trend which is expected to continue.

Sub-Saharan Africa remains the worst-affected region, with some 22.5 million people living with HIV (67% of contaminated persons¹ and 72% of deaths due to AIDS), even though the benefits of antiretroviral treatment are plain to see on the African continent, where a 20% reduction in the number of AIDS-related deaths was recorded between 2004 and 2009, with regional disparities.

The spread of AIDS is falling in many of the countries most affected by the epidemic (more than 25% reduction in the incidence of HIV* in the decade from 2000 in 33 countries, of which 22 are in Sub-Saharan Africa) where prevention and access to treatment were improved. Conversely, the number of HIV-AIDS cases rose by more than 25% in the same period in several Eastern European and Central Asian countries.

Subject to access to prevention, treatment, and care, as well as due regard for the rights of the person affected by HIV-AIDS², the continuation of these trends in the future will largely depend on the efforts deployed by all parties concerned (countries affected, international organisations, private bodies, etc.) that take part in the fight against this epidemic.

According to UNAIDS, only one-third of the people in need of therapy to treat HIV actually receive it (including five million people in low-income countries), and it would be possible to avoid 10 million additional deaths by 2025 thanks to the Treatment 2.0 initiative³.



STEP CHANGE

The hoped-for development of an AIDS vaccine, not expected before 2020, will be a turning point, but will initially raise the problem of access to treatment for many emerging or developing countries.



STEP CHANGE

If funding is sustained, the virtual elimination of mother-to-child transmission of HIV could be achievable within the next few years (2015).

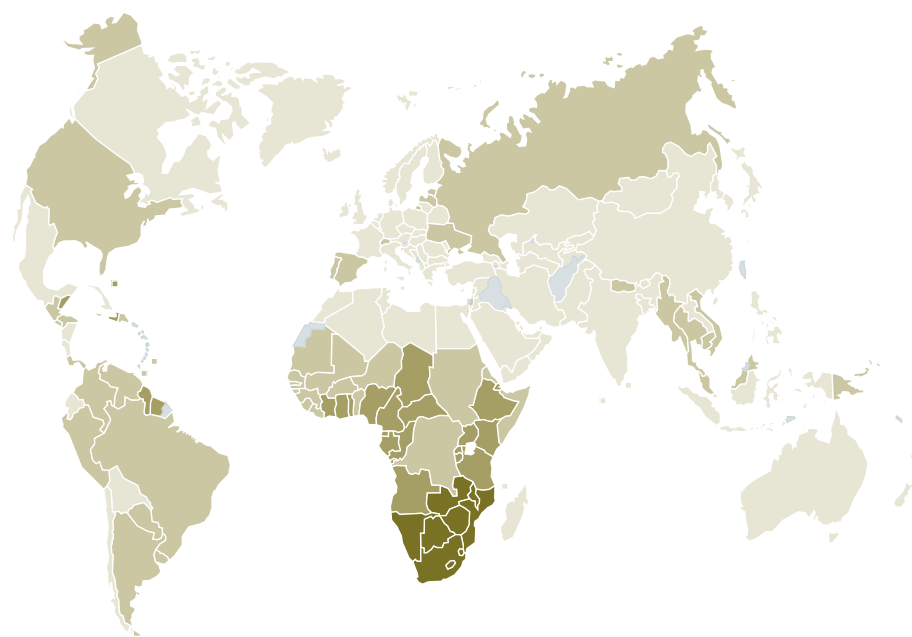
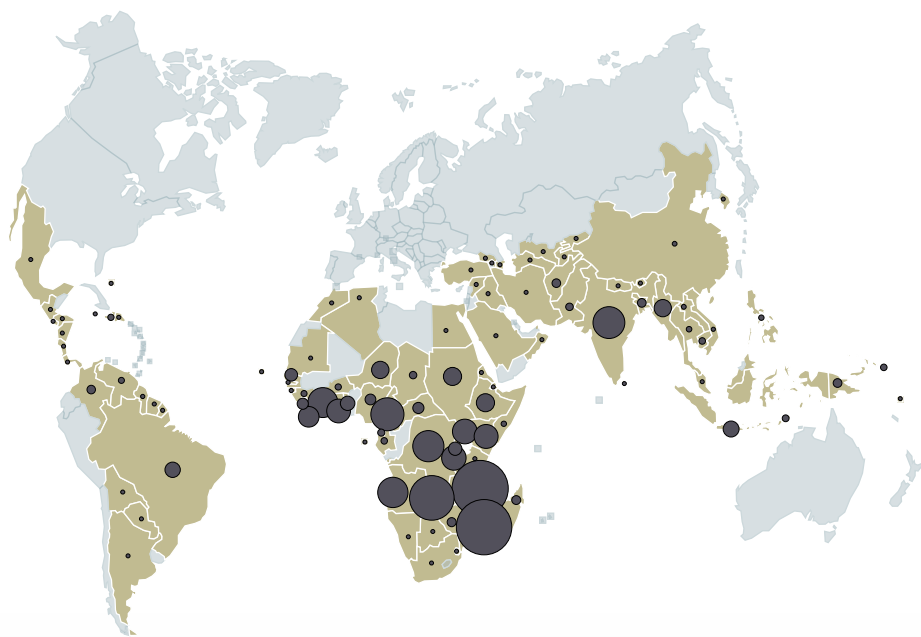
The trend concerning malaria is also encouraging. The number of cases recorded has gone from 244 million in 2005 to 225 million in 2009, essentially on the African continent (85% of cases) and Southeast Asia (10%)⁴, whilst the number of deaths has fallen over the course of a decade from 1 million to 780,000.

1- *Report on the Global AIDS Epidemic*, UNAIDS, 2010.

2- Punitive laws and discriminatory practices (same-sex relations are criminalised in 79 countries) as well as gender inequality and stigmatisation of HIV-infected people continue to hamper efforts to extend access to health care and HIV-related services.

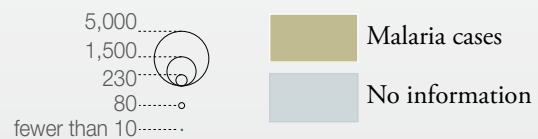
3- Treatment 2.0 is a new approach aimed at simplifying the way HIV treatment is currently provided and to extend and scale up access to life-saving medicines.

4- *World Malaria Report*, WHO, 2010.



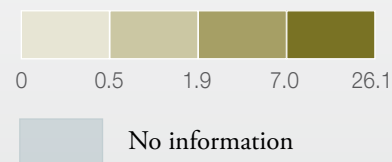
Malaria and AIDS, 2008

Number of malaria cases (thousands)



Note: the figures for the following countries are estimates:
Albania, Bahrain, Cyprus, Jordan, Kuwait, Libya, Oman, Qatar,
Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen.

Prevalence of AIDS among adults aged 15–49 (%)



Sources: OMS, 2009 *World Malaria Report*, <http://www.who.int/malaria/en/>

Sources: UNAIDS/WHO, 2008 *Report on the global AIDS epidemic*



STEP CHANGE

At the rate of progress recorded in recent years, malaria may no longer be a public health problem in the next 10 years in the countries where the disease is endemic. A first-generation candidate vaccine (GSK) is currently in Phase 3* clinical testing in Africa. By 2025, this could lead to the development of a malaria vaccine with at least 80% protective effect against the disease, providing more than four years' protection.

* Phase designed to test the vaccine's effectiveness and which can last for up to several years. Tens of thousands of volunteers may participate in the phase in order to obtain authorisation to market the vaccine.

Whereas progress is being made against malaria and HIV-AIDS, certain diseases that were on the decline are now on the upswing. One example is tuberculosis, with nine million new cases each year¹. Its prevalence is very unevenly distributed but remains high in Southeast Asia, where particularly lethal multiple-resistant forms account for one-quarter of cases.

The rise of multiple resistant tuberculosis, which is expected to result in two million new cases between now and 2015 according to the WHO, contributes to increasing the risk of spread of drug-resistant strains, making it all the more difficult to reverse the current trend.

1- *Global Tuberculosis Control Report*, WHO, 2009.



The most notable emerging diseases in the last 40 years have been AIDS, SARS, chikungunya, and the threats of an H1N1 flu pandemic, but pathogenic agents are evolving and multiple-resistant bacteria are appearing (nosocomial infections, tuberculosis) and viruses are mutating (influenza)¹. The understanding of infectious diseases has gradually changed from a matter considered to be in the course of being resolved and whose impact (except for AIDS) seemed to concern mainly developing countries, to a growing, not easily predictable matter of global concern².



STEP CHANGE

Many step change events could occur, such as a new highly pathogenic and extremely lethal pandemic, the introduction of yellow fever onto the Indian subcontinent, the release of the smallpox virus from a containment laboratory, or the emergence of a highly pathogenic virus from a species of pet.

FOCUS

The importance of environmental factors with regard to health

Almost a quarter of the overall load of disease in the world is related to exposure to environmental risk factors, particularly in developing countries. Climatic factors and air pollution are the most significant causes of morbidity.

By 2040, under the effects of environmental deterioration, intensified exchanges, demographic growth, urbanisation, and increased population density, the environmental impact on health should be considerable and unevenly distributed, to the detriment of the most fragile populations³.

The first effects of climate change could have a particular knock-on effect on the geographical range of certain diseases, such as dengue, which could appear in regions that had not previously been affected.

1- *La note de veille* Centre d'analyse stratégique No. 42, 22 January 2007.

2- *Notre stratégie pour les sciences de la vie et de la santé*, Inserm, December 2009.

3- 'Environnement et santé humaine en France : quels défis pour l'action publique et le système de santé?', Centre d'analyse stratégique, *La note de veille* No. 125, March 2009.



Operation AEDES
to control the
chikungunya epidemic
on Reunion Island,
March 2006

DOMINIQUE VIOLA/DICOD

3 Technologies serving health care

In the coming decades, the ageing of the population and the increase in cases of sedentary lifestyle will affect the health care systems in most developed countries. In a context of economic restrictions, the introduction of new technologies could contribute to the necessary optimisation of the health care cycle (prevention, screening, diagnosis, treatment, monitoring). In developing countries, technological developments could improve the health situation by curbing certain infectious diseases (development of new vaccines, antibiotics). But there is also a risk that new technologies could widen the gap between countries in the North and South.

3.1 - Technological advances in support of autonomy

Telehealth, which is now common in many fields—teleconsultation, teleimaging, medical telemonitoring in hospital and at home, real-time tele-epidemiology to trigger alerts, particularly the emergence of an epidemic—is expected to become more widespread in the coming years. In parallel, the combination of information technologies and robotics will develop over the next decade, most notably with the deployment of robot-assisted remote surgery.

In view of the ageing of the population, the need for human services will continue to grow¹. Certain developed and emerging countries, particularly in Asia (Korea, Japan, and China) are investing massively in robotics in order to provide solutions to assist dependent persons (robot companions) in about 30 years' time.

1- 'Les technologies pour l'autonomie : de nouvelles opportunités pour gérer la dépendance', *Note de veille*, Centre d'analyse stratégique, December 2009.

3.2 - New therapeutic strategies thanks to advances in biotechnologies

Today, biotechnologies are very widely used for the production of recombinant proteins and monoclonal antibodies² as well as the production of biomedicines, which already form a major part of the therapeutic arsenal. Cell therapy, following on from transplant techniques, is used to regenerate tissues thanks to the properties of stem cells. Therapeutic tests are underway all over the world, in the fields of myocardial repair, bone repair, or skin repair for burn patients. Cell therapy is also directed at exploiting the potential of cells that have remained in place to guide reparative or regenerative scarring. Applications can be envisaged in the medium term.

Complete sequencing of the human genome was a major advance for the diagnosis and treatment of monogenic pathologies³. The spectacular drop in the cost of sequencing (divided by 10,000 in 10 years) is expected to continue, and ultimately allow the development of gene therapy techniques that would be useful for the treatment of pathologies related to the deregulation of certain genes, such as cancer.

2- *Médecine/Sciences*, 'anticorps monoclonaux en thérapeutique' (special issue), 25 (12): 995-1196; 2009.



Professor Houlgate's team using a da Vinci robotic surgical platform in the operating theatre of Val-de-Grâce hospital, 14 January 2011

Pharmacogenomics¹ allows the therapeutic effectiveness of a drug to be tested in advance thanks to the specific genetic characteristics of each individual. The development of this technology, like the use of biochips or biomarkers, will allow diagnoses and treatments to be individualised.

3.3 - Promising technologies for the future: nanotechnologies and synthetic biology

With strong potential for application in the health field, particularly for diagnostics, drug delivery systems and regenerative medicine¹, nanotechnologies could improve medical imaging through better visualisation and detection of abnormalities on a molecular scale, in particular thanks to the introduction of nanoparticles acting as markers. This ultrasensitive detection would be particularly useful for the detection of cancers at an early stage.

Lab-on-a-chip devices, which can reduce the volume of samples taken from a patient, the time (earlier diagnosis), and the cost of tests, is expected to come into general use in the next decade (miniaturised nomadic devices, earlier diagnosis).

The doubts concerning the toxicological and environmental risks related to nanotechnologies should be lifted by an active research effort in these areas. Their use also raises ethical questions that must be studied and debated.

¹- *Roadmaps in Nanomedicine Towards 2020*, Joint European Commission/ European Technology Platform Nanomedicine, October 2009.

STEP CHANGE

The convergence of nanotechnology, biotechnology, information technology, and cognitive science (NBIC*) opens up considerable medical prospects thanks to the interaction of these disciplines, which is believed will improve their performance. Compensating for handicaps is an example of the application of these technologies, which could result a few decades from now in the improvement of human performance (improved sensory perception and cognitive capabilities). The very fine line between the repair and improvement of humans ('augmented man') will raise problems of bioethics, which will be specific to each culture.

* *Nanotechnology, Biotechnology, Information technology and Cognitive science: Converging Technologies for Improving Human Performance*, National Science Foundation (NSF), 2002.

At the interface between molecular biology and engineering sciences, synthetic biology, a booming area, could be the next revolutionary field. The recent creation of the first living cell with a synthetic genome¹ opens up the way to the manufacture of artificial organisms, which are likely to have many applications in the field of health (detection of chemical and biological threats). Synthetic biology could also allow the creation of biomaterials or medicines and be used to detect and correct pathologies at an early stage.

1- 'Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome', Craig Venter Institute, *Science*, 20 May 2010.



Laboratory in Shanghai,
China

The aim of this work is to design biological systems and completely reprogram living organisms in order to make them execute desired functions (even if they do not exist in nature). Such work must be strictly supervised, not only because of the risks in terms of biosafety and biosecurity, but also because of ethical considerations, particularly regarding the concept of life.

3.4 - Towards preventive, predictive, personalised and regenerative medicine

Thirty years from now, the countries that benefit from these new technologies (nanotechnologies) will thus have access to a more preventive and individualised form of medicine. The possibility of combining detection and treatment, allowing for the specific features of each organism, should allow the number of procedures performed on a patient to be reduced, and the therapeutic efficiency to be increased with better targeting.

Based on gene therapy and stem cells, regenerative medicine will develop thanks to advances in gene and cell therapy, synthetic biology, and nanotechnologies. It will allow bionic repair by sensory and motor prostheses directly interfaced with the central nervous system.

All of these developments, like predictive medicine, based on genetic analyses, should transform care medicine into health preservation medicine, which will raise many ethical questions; in the long term, the physical integrity of man could be called into question.



STEP CHANGE

Life sciences are developing at an exceptional rate: high-speed sequencing, directed molecular evolution, combinatorial chemistry, synthetic biology, etc. The combination of biotechnology with nanotechnologies, microencapsulation and aerosol technologies, and their increasing accessibility will increase their potential and the risks of double use and the proliferation of CBRN events. Whilst the biological effects of less-lethal weapons, based on the use of microwaves and electric shocks, are not well known, new miniaturised 'nano' weapons could be created, as could mixed CBRN weapons, dirty bombs, or attacks using highly contagious infectious diseases. With the number of P4 laboratories¹, which are equipped to handle highly pathogenic Class 4 agents, and specialist infectiology departments rising, biosecurity and biosafety measures will need to be reinforced.



The Morphée intensive care unit for long-range MEDEVAC patients

ÉRIC LE PICHON/ECPAD

4 Health system and health governance

Health care systems around the world, including in France, are still mainly dominated by a curative approach in which patients wish to participate in their own health care, to the detriment of prevention, research, and medical training. Technical and scientific progress, however, should allow a more predictive type of medicine to be practised, better adapted to the characteristics of each individual, so that the hospital-centric[□] approach can be reduced.

4.1 - Strong pressure on health industries

With the world drug market set to double in the next 10 years¹, driven by emerging countries, biotechnologies represent the way of the future for this industrial sector.

The expiry of patents, the new situation with generic drugs, and the end of the traditional blockbusters[□] constitute decline factors, which the drug industries in developed countries will need to face in a context of increased competition from emerging countries. The rising pressure of health care costs will require that medicines that are reimbursed by coverage schemes to be increasingly effective². Finally, the pharmaceutical industry must also face other challenges, such as the appearance of functional foods[□] and nutraceuticals[□], whose penetration rate on the world market 20 years from now could reach 10 to 20% of the nutritional products consumed.

Medicines are now beginning to be understood as emerging contaminants³. This means that medicines and their metabolites[□], present in water following their emission from industrial sites, inappropriate disposal by consumers, or directly eliminated by the

human body, are currently ignored by the laws and regulations concerning water quality, and are not treated by the current water purification plants. All of the medium or long-term effects of these new contaminants on aquatic ecosystems and human health are not currently known, but they constitute a new issue that will need to be taken into account by pharmaceutical industries and public authorities⁴.

In the area of life science research, France lags far behind the USA, Japan, Germany and the UK⁵, and is no longer amongst the front-runners of the industrialised nations. China and India, which alone represent almost 20% of research investment, could be innovation leaders by 2030.

1- *Pharma 2020, The vision: which path will you take?*, PriceWaterhouseCoopers, 2007.

2- 'Global pharmaceutical perspectives', IMS, *Intelligence*, 2006.

3- 'Pollution by Psychoactive Pharmaceuticals in the Rivers of Madrid Metropolitan Area (Spain)', Silvia González Alonso et al., *Environment International*, February 2010.

4- Studies are currently under way to determine the impact of pharmaceutical residues (antidepressants, hormones, antibiotics) present in wastewater on biodiversity (aquatic fauna). See 'Anti-depressants make amphipods see the light', Alex T. Ford et al., *Aquatic Toxicology*, June 2010, and 'Les crevettes deviennent folles', *Le Point*, July 2010.

5- Observatoire des sciences et des technologies, *Key Figures On Science and Technology*, 2006.

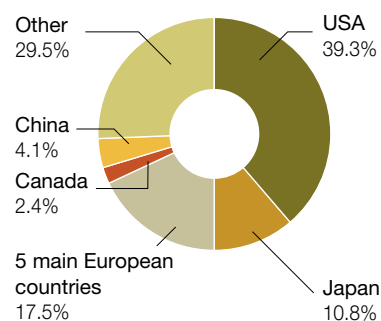
4.2 - Supranational governance that must be based on the national systems

With globalisation generating ever more exchanges, the continuing increase in personal mobility, and the generalisation of the determining factors of non-communicable diseases (such as tobacco addiction), the health risk is becoming global and will be accentuated, requiring the strengthening of governance mechanisms and co-ordination and the development of co-operation tools (early warning systems, crisis management systems, etc.).

Due to a newfound awareness of the common threats, prospects, and challenges that make health care a global issue, the nations now accept the need for an international health care governance body. However, because the risk governance method must take the citizens' desire for participation into account, as well as their high level of risk aversion, the decision process becomes increasingly complex and arbitration more difficult. This is the price of increased legitimacy and the possibility of teaching the participants about risk prevention.

The issue for organisations like the WHO, which is fundamentally intergovernmental, will thus be to respond to the challenge posed by the large number and growing diversity of participants in the health care field, based on the triad governments/NGOs/private participants (the growing position occupied by non-governmental players, international organisations, companies, private foundations, 'vertical' funds¹). However, the increasingly complex nature of the co-operation and collaboration between the world's health care players should not undermine the action framework, which is in the purview of states in the first instance.

Finally, the recent risk of a worldwide avian flu pandemic served as a reminder that the organisation of an international health reaction capability that could, most notably, halt or limit the development of an epidemic in countries not possessing the resources to do so themselves effectively, will constitute a major health issue in the coming decades.

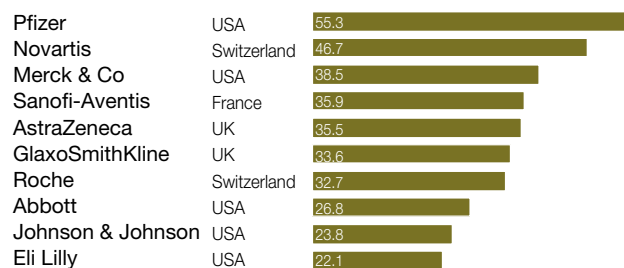


2010 pharmaceutical market

Percentages of global market share

In 2010, the global pharmaceutical market was worth an estimated \$862 billion, versus \$200 billion in 1990.

Source: LEEM, www.leem.org, based on information from IMS Health



The top 10 companies

Sales revenue in billions of dollars

The pharmaceutical market is relatively fragmented, with the top five firms accounting for just 27% of the global market (vs. 40% in the IT market, 50% in the auto market and 80% in the aerospace market).

Source: LEEM, www.leem.org, based on information from IMS Health

Map Department of Sciences Po, 2011

1- *The World Health Report 2008 - Primary Health Care*, WHO, 2008.

4.3 - A health care system financing crisis

In 2010, worldwide health care expenditure totalled almost 150 billion euros. In 2030, this could have almost trebled (430 billion euros¹)². This general trend will raise the question of the ability of states to provide consistent and affordable cover, which will be dependent on the evolution of the national GDPs. This trend will concern developed countries (ageing of the population, change in the typology of morbidity, growing technification, etc.) as well as emerging countries (change in the typology of morbidity, change in the architecture of health care systems with, in particular, a significant rise in the number of health care personnel and the amount of medical infrastructure, etc.).

With regard to the demographic changes that will necessitate an increase in the collective coverage of health care expenditure, in the coming years this expenditure could grow faster than the current rate.

However, better utilisation of the health care systems (health promotion policy, particularly prevention; public and social control of pharmaceutical companies; international co-operation and development of joint research programmes, reduction of costs and the price of access to medical care and medicines, etc.) would optimise the spending, without this necessarily being incompatible with social progress. This change will depend on the courses of action decided upon at the national level.

Private funding, which is particularly useful in R&D, places a special risk on the health systems of developing countries because of its impact on world health priorities. These countries, which already have difficulty treating common diseases, will have to cope with the rise in cardiovascular diseases, cancer, and the consequences of the ongoing deterioration of the environment.

Whilst one person in five worldwide does not benefit from large-scale welfare protection and almost half the population has no form of welfare protection (only 5% to 10% of persons are covered in Sub-Saharan Africa and in Asia), the question of universal health cover, which would be the only way to reduce the inequalities, will be raised with increasing urgency.

1- Versus 240 million euros with a rise in expenditure of no more than 3% per year.

2- 'Future Budget Pressures Arising from Spending on Health and Long-Term Care', OECD, *Economic Outlook* No. 79, 2006. *Projecting OECD Health and Long-term Care Expenditures: What Are the Main Drivers?*, OECD, 2006.

5 Societal changes and ethical aspects

In the face of scientific and technical developments, major ethical and, especially, political challenges could arise in the coming years. They will concern emerging forms of *transhumanism*[□] or *post-humanism*[□] and the question of the control that is desirable on all the available techniques: Who? How? and, above all, With what objectives? For the present, these complex issues remain difficult to grasp.

Well-person medicine (well-being and prediction of illness), the more personalised approach to pathologies (advances in genetic knowledge), and paying the costs of dependence should occupy a predominant place in the next three decades.

The difference in standards between countries causes concrete problems of competition between states (H1N1 vaccination in China). The legislation concerning animal testing limits neuroscience research. The regulatory constraints should thus lead to the emergence of new leaders and the relocation of certain activities (research and production).

Nanoscience, biotechnologies and cognitive sciences pave the way for an 'Augmented man'. The boundaries between therapeutic medicine and improvement medicine are difficult to define, particular in elderly patients. The question of the boundary between fighting the degradation of bodily faculties and improving these same faculties then arises.

Our very idea of health and illness is thus brought into question by emerging sciences. Nanotechnologies, which are likely to concern a healthy person, could thus lead to a new definition of pathology.



STEP CHANGE

The growing role of life science techniques could accelerate a cultural and moral paradigm shift and transform our relationship with death and the body. The sacredness of the human body could give way to a utilitarian notion of the body.

These trends could form a part of a broader approach of implementing a 'scientific and health care democracy'.

Would it then be up to society and its representatives, rather than doctors, to define the meaning of a 'sick person'? Certain principles must remain at the forefront: equality, identity, dignity, freedom, individual interest, and general interest. It is important to discuss and define the boundaries between a 'reconstructed man' and a 'transformed man', which implies a violation of the personal structure of the individual. Rampant eugenics could be hiding behind the most laudable use of predictive medicine; the movements of transhumanism and post-humanism attest to this fact.

⇒ CONSEQUENCES FOR DEFENCE

Dealing with new risks and constraints will require major adaptations

The demographic changes in the health care professions, both nationally and internationally, will affect medical care in the public service and the armed forces. Health care personnel will need to maintain the versatility required under engagement conditions despite the extreme specialisation of medicine. An effort to achieve increased international collaboration by health departments must be made, whilst preserving a certain degree of freedom of action on a national level.

Faced with the increase in CBRN threats and hazards, genetic manipulations—the synthetic biology or nanotechnologies liable to be used as weapons by state or non-state players—the defence department must possess research and development capabilities to examine means of detection and diagnosis of highly pathogenic infectious agents and modified or synthetic biological agents, as well as the associated therapeutic options.

The health products chain must be secured with regard to both the security of flows and the manufacture and storage sites, particularly for national stockpiles. This control of health supplies will be necessary for forces in operation or in the event of a major health crisis.

Risk aversion, the demand for quality and the development of a precautionary approach, driven by changes in society, will impose the deployment of increasingly efficient support resources based on the new telehealth applications and the new life science technologies. If therapeutic progress is slower than the increase in risk, a shear effect will be felt on recruitments, or even on operational engagements.

The changing nature of operational engagements will make the handling of wounded personnel more complex, and the means of evacuation will need to be adapted. The military health care service will therefore need to have resources for protection and fast extraction, large logistical flow capabilities, and highly modular operational medical units.

In the event of a pandemic, military personnel will probably be called upon, especially in the case of a pandemic with a very high morbidity rate. Moreover, in that case, the dilemma concerning the distribution of limited supplies of antiretroviral products and vaccines would arise.

Technological advances serving the combatants

The forces' preparation for engagements will benefit from technological advances, which will allow the specific constraints of new theatres of operation to be better identified thanks to heightened health surveillance. The combatant will be better informed, more efficient, and less vulnerable.

The 'combatant-patient' will be assisted thanks to sensors based on new technologies, enabling him to be *monitored* and quickly processed remotely thanks to chips containing radiofrequency identification (RFID[®]) systems.

In the longer term, the scenario leading to an adapted or 'augmented' combatant, or even a genetically enhanced combatant, cannot be ruled out.

Increased budgetary pressure

In a context of already significant financial constraint for European states, the budget allocation required to satisfy sanitary and health care needs will automatically grow. With total proportional health expenditure having risen from 3.4% of GDP in 1960 to 11% today, France will be no exception to this trend. It will be especially dependent on the change in costs related to medical progress: in the event of a rate of growth that is double the current rates, the proportion of health spending would reach 21% of French GDP by 2050.

Even though this is only a strictly trend-based approach, its consequence would be to lead to arbitration decisions unfavourable to the Defence department, or even—in the case of long-term financial stagnation or a significant increase in the proportion of inactive members of the population, for example—incompatible with the preservation of a critical capability.



NVG operations
by the 126th line
infantry

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