RECOMMENDATIONS

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There will always be infectious diseases. Animal-acquired infections, or zoonoses, will become an increasingly significant factor in the emergence of human infections. The challenge posed by zoonoses can only be met if we give infectious diseases the status of an utmost important national and international cause. Such an objective requires the mobilisation of unprecedented financial, human and technological resources in the service of multi-disciplinary research bringing together biology, epidemiology, social sciences, human studies and economics.

Such an effort is the only guarantee that the knowledge that is indispensable for controlling infectious diseases will be acquired. This implies:

- encouraging a close collaboration between leading academic research and industrial research structures;
- ensuring better coordination between national and international surveillance, warning and intervention systems;
- realising that animal and human pathology must be integrated into a single global concept for education and research purposes;
- educating the general public to better recognize, understand and respond to an infectious risk.

The emergence of infectious diseases is by definition unpredictable. Only a global research effort would ensure a shift from the current reactive approach to an anticipatory and proactive approach, especially in the field of virology.

The following specific recommendations are indispensable:

1. New diagnostic tools, anti-infectious agents and vaccines should be developed. This requires a close link between academic research and the pharmaceutical industry in order to revive an interest in these essential fields of research and development.

Innovative funding and support mechanisms need to be created, involving in particular national governments, international institutions and major private foundations.

The potential of industrial partners in emerging countries should be developed.

2. All aspects of epidemiology should be strengthened: surveillance, model-building of epidemics, predictive algorithms, data collection and dissemination. We recommend also evaluating the public cost of infectious diseases. Progress in the integration of national and international systems and efforts to make them coherent must be made taking into account the newly created *European Center for Disease Control*.

Specific effort should be made towards integrating the surveillance systems of human and animal infectious diseases.

3. Research in fundamental microbiology and parasitology should be supported.

Genomics and metagenomics of pertinent ecosystems should be used as tools to further our knowledge of the diversity of the microbial world that confronts us.

High-throughput tools should be developed to study the phylogeny and the taxonomy of microbial species.

Innovative diagnostic tools need to be developed to isolate, enrich and identify infectious agents rapidly, in particular emerging agents and agents likely to cause infectious diseases.

Efforts to study the physiology and metabolism of micro-organisms should be revived in order to enhance research in new anti-infectious agents.

4. The study of the physiology and the pathology of infectious diseases and the immune responses of the hosts should be supported.

The fusion of microbiology, immunology, cell biology and structural biology should be encouraged so that the molecular mechanisms at the basis of the interactions between microbial effectors and cells can be unravelled. Such data should be integrated in our models of the overall infection process.

Microbiology should be opened to other disciplines, such as genetics (host variability to certain infectious agents) and developmental biology (repair of infected tissues).

New analytical tools, in particular real-time imaging of the infection process at the level of the cell, the organ and the host should be developed.

The study of homeostatic mechanisms allowing tolerance to commensal flora should be encouraged.

The study of chronic infectious processes should be encouraged because of their role in the etiology of some cancers and likely role in some autoimmune diseases.

5. Studies aimed at identifying pathogen vectors and reservoirs should be encouraged.

Current knowledge on the biology of vectors, in particular arthropods, and their interaction with the pathogens should be strengthened.

Pathogen reservoirs should be identified and the mechanisms at the basis of their survival in the environment or in animals should be studied.

Computer models of complex environments such as the hospital environment and the food industry environment need to be developed.

The crossing of species barrier is an important phenomenon leading to the emergence of new human pathogens. Therefore, the surveillance of animal infections in our regions as well as in developing countries should be strengthened. The mechanisms allowing for species crossing must be investigated.

6. Research on resistances to anti-infection agents and the mechanisms underlying the appearance of such resistances should be enhanced because of the importance of these processes to public health. Of particular importance is the understanding of the mechanisms and genetic basis of resistance to anti-infectious agents and the implementation of surveillance and early warning systems.

7. Infectious and parasite-born diseases that are prevalent in developing countries should be integrated into our research priorities.

The contribution of social sciences and human studies should be integrated into the development of tools used in the control such diseases.

Research efforts should not be limited to three main diseases (AIDS, tuberculosis and malaria) even if they have a significant weight on public health. More attention should be paid to severe respiratory infections, enteric infections, parasitic infections (leishmanioses, trypanosomiasis, filarioses, bilharziosis) and hemorrhagic fevers.

Research on veterinary infectious diseases should be encouraged because of the impact of these diseases on the economy and their potential for moving into humans.

Coordinated actions between the various French institutions providing help to developing countries, in particular IRD, Cirad and the international network of Pasteur institutes should be supported and partnerships with foreign laboratories should be encouraged.

8. All aspects of clinical research, diagnostic, therapeutic, physiological, pathological and immunological, should be strengthened worldwide.

Weaknesses should be addressed: insufficient infrastructure, insufficient number of doctors, nurses, paramedical and administrative personnel with scientific education.

More effort should be made towards the scientific education of doctors and veterinarians.

9. Teaching of microbiology and infectious diseases should be adapted to the rapid evolution of these disciplines in scientific universities and medical, pharmaceutical and veterinary schools.

More importance should be given to fundamental research within these structures of academic education.

Specific attention should be given to some key areas:

- fundamental aspects of epidemiology and public health should be considered as part of a multidisciplinary concept that integrates computer sciences, biomathematics, information sciences and human studies;
- microbiology, immunology, genetics and comparative pathology should be taught within a global academic course on infectious and parasitic diseases;
- teaching of the biotechnological aspects of the diseases, such as diagnostic, immunology and therapeutics, should be strengthened.

Student and researcher mobility should be encouraged in Europe and a specialized School of Infectiology should be created at the university level.