# Science for Health and Well Being

## The Impact of Technology on Hypercommunicable Disease Processes (Global Risk Analysis and Control)

The rapid spread of communicable diseases has become a grave global problem. Propagation of highly infectious agents across national boundaries can be extremely efficient and rapid as international air travel becomes increasingly popular. The seriousness of the problem has recently been demonstrated with the quick spread of SARS. New, highly contagious, yet unknown diseases, resistant to existing treatment may originate anywhere in the world and be transmitted globally. In addition to human and animal carriers there is the potential for food and water borne diseases. Moreover, there exists the threat of intentional release of biological agents into the environment or into the water or food chain.

A large number of ICSU Unions, with their extensive science and engineering communities are capable of making enormous contributions to reducing these risks to human existence. Since any country or region may be the source of the disease, the effort must be global in nature.

The main issues to be addressed include the development of effective surveillance, rapid and reliable detection and identification of the pathogen, diagnosis of infected individuals, an early warning system, a global infrastructure to isolate the infection, treatment, and remediation. The elements that are needed to implement a global system with the required features entail 1) new research efforts, 2) adaptation and deployment of existing technologies, and 3) close coordination and communication between the science, engineering and clinical communities.

New research efforts include the development of reliable broad spectrum detectors and highly sensitive sensors; technologies for rapid detection of agents that have not been widely evaluated or well validated in real-world settings; new molecular technologies for surveillance, for sensitive detection, for identification of pathogens, and rapid and accurate diagnoses; use of genomic and proteomic information, as well as the development of sensing devices that can communicate signals and offer new possibilities for the early detection of biologic agents; increasing our knowledge of the pathogenesis of and immune responses to biological infectious agents, development of new drugs, vaccines, and devices; methods to identify infected persons, animals, or plants before they develop overt disease; assessment of effective treatments; and mathematical modeling of disease transmission and distribution of various agents to help evaluate the potential and relative value of different surveillance and diagnosis systems.

Deployment of existing technologies include, among others, a robust global information infrastructure; a high speed communication system, fast access and data validation; standards for data input, storage and communication; reliable detectors that can be used in the field; portable and inexpensive imaging and data processing systems; the application of data fusion and data mining techniques; application of epidemiological analysis to screen for specific symptoms and patterns; and an integrated global system that can detect and report diseases electronically in real time.

Communication between the basic science, social science, engineering and clinical communities should accelerate efforts by establishing cross-disciplinary research efforts

and forging technology-deployment teams; by instituting effective training programs; and enabling rapid identification of and responses to the occurrence of infectious agents.

An important byproduct of establishing and maintaining such an integrated global system would be to lay the foundation for development of an infrastructure for remote diagnosis and treatment, providing access to the underprivileged who currently have inadequate access to health care; capacity building in the developing countries in the area of research and applications to health; and a general improvement of the global health system.

**Implementation**

Establish collaboration with WHO, using as a basis the Global Public Health Intelligence Network that has already been established as a semi-automated electronic system to continuously search key web sites, newswires and online media sites, websites of national governments, public health institutions, and specialized discussion groups to identify early warning information about epidemic threats; recruit members of the Science and Engineering community in the areas of biology, microbiology, immunology, bioinformatics, medical physics and biophysics, and biomedical engineering for assistance and advice; promote collaborative research programs that enhance contact between members of the different unions; develop a database for locating related expertise in academic and industrial laboratories; chart methods for education and training of the related communities; and initiate planning for an "International Year of Science and Technology in Health and Well Being", focusing on global health issues.

**Players**

As shown below we expect that most Unions that are members of ICSU would have an interest and could play crucial roles in resolving parts of this initiative. Contributions of these unions as well as many of the international scientific associates could span multiple portions of the initiatives.

1. Biophysical vectors of disease transmission
    a. International Union of Biochemistry and Molecular Biology
    b. International Union of Biological Science
    c. International Union of Pure and Applied Biophysics
    d. International Union of Pure and Applied Chemistry
    e. International Union of Crystallography
    f. International Union of Food Science and Technology
    g. International Union of Immunological Societies
    h. International Union of Microbiological Societies
    i. International Union of Nutritional Sciences
    j. International Union of Physiological Sciences
    k. International Union of Pharmacology
2. Geophysical factors in disease transmission
    a. International Astronomical Union
    b. International Union of Geodesy and Geophysics
    c. International Geographical Union
    d. International Union of Geological Societies
    e. International Union of Pure and Applied Physics
    f. International Union of Soil Sciences

    g. International Union of Toxicology
3. Human factors in disease transmission and control
    a. International Union of Anthropological and Ethnological Sciences
    b. International Brain Research
    c. International Union of the History and Philosophy of Sciences
    d. International Union of Psychological Science
4. Systems analysis of disease transmission and control technology
    a. International Mathematical Union
    b. International Union of Theoretical and Applied Mechanics
    c. International Union of Pharmacology
    d. International Union for Physical and Engineering Sciences in Medicine
    e. Union Radio Scientifique Internationle

**Outputs**

Definition of system and data requirements
Workshops and publications
Increased collaboration between ICSU, WHO and policy makers
Improved dialog between ICSU unions

**Audience**

Science community
Universities
National health organizations
Policy makers
Healthcare providers
Healthcare industry
Educators

**Potential sources of funds**
WHO
Various health related foundations
Bill Gates Foundation
NIH
NSF
The European Union

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