Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Although inequality is often measured through three critical indicators—education, income and life expectancy—health-related differences are also essential elements for explaining levels of equality or inequality in modern societies. Investment and investigation in health also involve inequalities at the global level, and this includes insufficient North-South transfer of funds, technology and expertise in the health field, including the specific area of communicable diseases. Globally, epidemics and outbreaks in any geographic region can represent international public health emergencies, and this type of threat requires a global response. Therefore, given the need to strengthen the global capacity for dealing with threats of infectious diseases, a framework is needed for collaboration on alerting the world to epidemics and responding to public health emergencies. This is necessary to guarantee a high level of security against the dissemination of communicable diseases in an ever more globalized world. In response to these needs, international health agencies have put a number of strategies into practice in order to contribute to the control of communicable diseases in poor countries. The principle strategies include: 1) implementation of mechanisms for international epidemiologic surveillance; 2) use of international law to support the control of communicable diseases; 3) international cooperation on health matters; 4) strategies to strengthen primary care services and health systems in general; 5) promotion of the transfer of resources for research and development from the North to the South.
Global collaboration on the control of communicable diseases is also touched upon. Next, international cooperation on a range of health matters and efforts to strengthen primary health care and health systems in general in poor countries are referred to. Finally, a discussion is included about how international agencies facilitate the North-South transfer of resources for research and development and contribute to the implementation of these investments in the areas of research, surveillance systems and improvements to health.

**International Epidemiologic Surveillance**

Diseases that are rapidly spread, including a number of emerging and re-emerging infectious diseases, require surveillance systems with a high degree of sensitivity, which are also opportune. Surveillance systems with these characteristics allow rapid decision making and action to stop an outbreak from growing or to control an epidemic. Given the above, a new paradigm for global collaboration has been developed based on the establishment of surveillance networks at the international level. Epidemics and outbreaks in local regions can represent an international public health emergency. Although such situations require a global response, there is no single institution with the ability to guarantee health safety worldwide. Therefore, collaboration by international agencies, national governments and individuals with pertinent expertise is required.

Collaboration in this area has included the establishment of the Networks for Surveillance of Emerging Infectious Diseases, three regional structures operating in Latin America with the support of the Pan American Health Organization (PAHO) (2). These networks carry out epidemiologic and laboratory-based surveillance of emerging and re-emerging infectious diseases in the Amazon, Central American and the Southern Cone regions and provide a forum for information exchange, cooperation on capacity building and collaboration on quality control mechanisms, all aimed at the prevention or control of epidemics (3).

Another initiative in this area is the Global Outbreak Alert and Response Network (GOARN), which was established in 2000 under the guidance of the World Health Organization (WHO). GOARN provides a technical, multidisciplinary response to outbreaks and epidemics with a global outlook. This network aims to improve coordination of international responses to situations involving emerging and re-emerging infectious disease by focusing its actions on technical and operational support for national or regional efforts. GOARN assists countries in actions targeted at disease control by ensuring rapid technical support; investigation and risk calculation in epidemics; controlling outbreaks of diseases with the potential for spreading rapidly; providing technical advice and guidance; carrying out epidemiologic research; advising on clinical management issues; confirming laboratory diagnoses; handling dangerous pathogens; and giving logistic support and sending supplies (drugs, vaccines, reagents, medical equipment). GOARN constitutes a global resource that guarantees rapid access to experts and necessary operational resources for infectious disease control (see Box 1) (4).

**International Law, Global Collaboration and Communicable Diseases**

Traditionally, international law has been a central tool in the global surveillance of communicable disease. Throughout the 20th century, international law was decisive for coordinating quarantines in different European countries,
International legislation and norms have contributed to the exchange of epidemiologic information about infectious diseases in diverse geographic areas, justification of the establishment of international health organizations, and support for epidemiologic surveillance systems for communicable diseases.

As the world enters the 21st century, communicable diseases continue to stretch the limits of global health policy, carried out through the use of legally binding instruments and voluntary norms. Such legislation is discussed and adopted within the framework of multilateral institutions such as the WHO, World Trade Organization (WTO), Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE). International law has constituted an indispensable tool for the protection and promotion of health in the context of globalization. International legislation has also been useful in the application of global health policy aimed at reducing human vulnerability to mortality and morbidity due to communicable diseases (5).

The International Health Regulation, and particularly global regulations related to the control of infectious disease, have not been significantly modified since its proposal in 1951. Therefore, the WHO and PAHO have been involved in coordinating the review and modification of the International Health Regulation, which constitutes a series of guidelines for cooperation by countries on the control of disease outbreaks (6). The recognition of the need for changes in the International Health Regulation grew out of the emergence of new infectious diseases such as severe acute respiratory syndrome (SARS, see Box 2), (7) as well as the resurgence of re-emerging infectious diseases which for the Latin American region include cholera (8) and typhoid fever (9), while in Africa re-emerging diseases that indicate the need for this modernization of health regulations include influenza, (10) measles (11) and cholera (12) as well (Figure 2).

The WHO proposal for modernization of the International Health Regulation includes the following: 1) a mission with a stronger focus on control of infectious diseases, 2) emphasis on broader health care coverage and better access to treatment schemes, 3) global surveillance including data from official and non-official sources, 4) strengthening of national public health systems through the establishment of comparable productivity indicators and outcome measurements, 5) giving priority to the protection of human rights, 6) guidelines for good health governance defined as adoption of the principles of impartiality, objectivity and transparency (13). Above all, WHO needs to ensure all geographic regions establish health norms and structures that facilitate the transfer to poor countries of economic and technical assistance related to health.

The need for increased global capacity to deal with infectious diseases is what drives the creation of a collaborative framework for epidemic alerts and responses to public health emergencies that are of international concern. Such a structure should guarantee the highest level of security against the spread of disease with the least possible interference in other globalized processes such as commerce or travel. The best way to prevent the international spread of diseases is through opportune detection of and intervention into public health threats, while the problem is still limited. This requires early detection of unusual events

---

**Box 1. Ebola virus**

The largest Ebola outbreak ever recorded was successfully controlled in Uganda in 2001 through the efforts of the Ugandan government and an international team coordinated by the Global Outbreak Alert and Response Network (GOARN). More than 400 Ebola cases were isolated and treated and 6,000 contacts were tracked. After initial containment of the outbreak, follow-up was carried out through a community-based early warning surveillance system, establishment a field laboratory and creation of an isolation ward. GOARN provided logistic support and coordination in the field, which made quick and effective control of the outbreak possible (30).

---

**Box 2. SARS**

Severe acute respiratory syndrome (SARS), an atypical pneumonia of unknown etiology that is caused by a coronavirus, is an emerging infectious disease. It originated in the Guangdong province of China in 2002 and spread rapidly around the world through international air-travel routes. The initial global outbreak of SARS caused 810 deaths on 5 continents. It also implied a serious threat to socioeconomic stability worldwide. The WHO, through the Global Outbreak Alert and Response Network (GOARN), worked with local health authorities in the affected countries, providing epidemiologic, clinical and logistic support. This original outbreak was brought under control in 2003, although isolated outbreaks of SARS have occurred since. A SARS vaccine is currently in clinical trials in China (31,32).
through national epidemiologic surveillance and international coordination as part of an effective response to public health emergencies of international importance. When common challenges exist, common strategies are necessary to find solutions, as is sharing high-quality information in order to provide effective, evidence-based responses.

**International Cooperation on Health Issues**

Globalization has had multiple repercussions on international health, including the dissemination of certain infectious and vector-borne diseases, greater reach for bioterrorism and new health behaviors, among others. Against this global backdrop, cooperation among countries would seem the best way to ensure worldwide progress in public health matters (14).

However, international—and specifically North-South—cooperation on actions to promote greater health should not be limited to the control of communicable diseases. Particularly in many poor countries, it is important to reduce the burden of illness or ill health related to malnutrition (15). At times this may imply the existence of conflicting health priorities. International agencies and national institutions and governments will have to decide how limited resources can best be invested to achieve the greatest gains in the fight against ill health, be they through the control of communicable diseases or in the fight against malnutrition (16).

Of course, international cooperation on health issues cannot be the sole responsibility of poor countries; instead, developed and developing nations must collaborate. Developed countries should commit to resolving global problems, making an effort to recognize precisely their global qualities even when originally they are located (in geographic terms) in developing countries. On their part, the less-developed nations should work towards guaranteeing the sustainability of their health policies. A specific proposal for dealing with issues such as these is the establishment of a Global Research Council, which would contribute to making action-research more efficient as well as promoting faster uptake of new applied knowledge in the public health field. In general, in order to reach these goals, North-South collaboration is essential (17).

The initiative for global eradication of poliomyelitis in 1988 has various lessons to teach us about international cooperation. In the first place, each goal should be defined based on strategies that are technically feasible for large geographic areas. Secondly, before a strategy is implemented, an informed, collective decision should be negotiated and a consensus reached. In addition, financial risk should be minimal while the possibilities for implementation in a short time period should be maximized. Finally, global health interventions should take into consideration the available infrastructure within the local health systems and ensure sufficient resources—financial and in terms of health care systems—as was the case in the eradication of poliomyelitis (18).
Strategies to Strengthen Primary Care Services and Health Systems in General

There is a lack of efficacy in existing measures for stopping the spread of communicable diseases among countries. In order to create a foundation upon which to build communicable disease control strategies, to start with, health system infrastructure in developing countries must be strengthened (Table 1). This will involve the continual development of institutional capabilities for early detection and efficient and opportune intervention in emergencies linked to epidemics. For too long, many international agencies have given priority to other matters, including managerial capacity. Although these issues may be important, the end result has been the postponement of support for improving primary care. Therefore, international support for the control of communicable diseases should begin to include resources for strengthening local health systems (19).

Although some aspects of health problems, priorities and policy have become global, most of the responsibility for communicable disease control continues to be exercised at the local level. Therefore, a network for the “Global Public Good” has been proposed to improve communicable disease control in developing countries. This initiative proposes that failures and omissions in collective efforts to control communicable diseases can be overcome through the following actions: a) providing additional or matching funds to those offered at the local level; b) promoting investment by developed countries in the health systems of less developed nations; c) offering joint strategies for the global control of communicable diseases; and d) guiding the political process that will establish mechanisms for financing global communicable disease control programs (20).

In this context, an alliance of a number of agencies has been formed, including the United Nations, the governments of developing countries, governmental donors in developed countries, private foundations and corporations and non-governmental organizations. The goal is to mobilize, manage and distribute additional resources for the control, to begin with, of HIV/AIDS, tuberculosis and malaria. One high priority in the use of funding is the purchase of vaccines. However, there is still no consensus on implementing a strategy for financing and improving the health services of poor countries (21), and this will be something that should receive priority in the near future.

Priorities for North-South Transfer of Research and Development Resources

Research, development and funding priorities in the health field vary greatly in different parts of the world (particularly developed vs. underdeveloped), something which is linked to the insufficient North-South transfer of investment in health. One of the reasons this situation exists is simply that communicable diseases make up a much larger proportion of the burden of disease in underdeveloped countries as compared to developed ones (see Box 3) (22). A related problem is that research priorities are different in richer countries where chronic diseases are a priority than in poorer nations where infectious diseases and malnutrition

| Prevention measures | Impact on spread of: |
|---------------------|----------------------|
| Site planning       | Diarrheal diseases, acute respiratory infections |
| Clean water         | Diarrheal diseases, typhoid fever, Guinea worm |
| Water chlorination  | Diarrheal diseases, cholera |
| Good sanitation     | Diarrheal diseases, vector borne diseases, scabies, river blindness |
| Adequate nutrition  | Tuberculosis, measles, acute respiratory infections |
| Vaccination         | Measles, meningitis, yellow fever, Japanese encephalitis, diphtheria, tetanus, influenza, hepatitis virus, poliomyelitis |
| Vector control      | Malaria, leishmaniasis, plague, dengue, Japanese encephalitis, yellow fever, viral hemorrhagic fevers, Chagas disease |
| Personal protection with insecticide-treated nets | Malaria, leishmaniasis |
| Personal hygiene    | Louse-borne diseases: typhus, relapsing fever, trench fever |
| Condom use          | Sexually transmitted infections including human papillomavirus and HIV/AIDS |
| Health education    | Infectious diseases as a group |
| Prevention measures and level of secondary prevention: | Impact on spread of: |
| Case management     | Cholera, stigellosis, tuberculosis, acute respiratory infections, malaria, dengue, hemorrhagic fever, meningitis, typhus, relapsing fever, syphilis, gonorrhea, chlamydia, chicken pox, HIV/AIDS |

Reprinted from The Lancet, 364, Connolly MA, Gayer M, Ryan MJ, Salama P, Spiegel P, Heymann DL, Communicable diseases in complex emergencies: impact and challenges, 1974–1983, 2004, with permission from Elsevier.
Box 3. Tuberculosis
After antibiotics began to be used to treat tuberculosis patients in developed countries beginning in the 1940s, the control programs for this disease underwent radical transformations in these nations and tuberculosis incidence and mortality rates declined steadily in the industrialized world. The developed nations began to ignore the disease, and resources available to developing countries for dealing with it dried up. The treatment options used in developed nations were unaffordable for developing countries, where instead strategies such as ambulatory care and passive case detection were preferred in order to lower treatment costs and avoid expensive mass screening. Studies carried out in developing contexts produced useful schemes for other resource poor settings. Investigation undertaken in India confirmed the effectiveness of treatment of tuberculosis in patients’ homes and provided alternatives to costly mass screening. Research supported by the Ministry of Health of Tanzania provided the groundwork for the development of DOTS (Directly Observed Treatment Short-course), which is now the leading global intervention against tuberculosis. However, these research results were not applied in many poor countries, given the almost total absence of tuberculosis on the international health agenda and especially the lack of funding. It was not until tuberculosis incidence began to rise in developed countries such as the United States and a number of European nations in the 1980s that international concern was again focused on this disease, including resources. At this juncture, the World Bank made tuberculosis a priority and provided loans for the implementation of WHO-DOTS, after which 120 countries adopted this scheme (16).

are of greater concern. Even when chronic diseases constitute an important proportion of the burden of disease in developing (often middle-income) countries, research needs may be different from those in developed nations. Specifically, interventions to prevent chronic diseases, or to improve adherence to treatment once acquired, which may be successful in developed countries can be either not feasible or inappropriate (in cultural, social or economic terms) in developing nations.

In addition, the development of vaccines in developed countries, for the control of communicable diseases, can be of little use in poorer nations, where they may be ineffective given the existence of different viral strains or bacterium. Quality of health care services is quite heterogeneous from one country to another, both when comparing developing countries with one another or with their developed country counterparts, which again implies different research and funding needs. Finally, the high cost of patented medicines and medical technology limits their transferability from richer to poorer nations.

The new health environment is highly complex and therefore the proposals being made to improve it are extremely heterogeneous (23). Certain international agencies have contributed to successful inter-institutional and international collaboration on scientific capacity building, joint research programs and technology transfer. To establish the basis for North-South discussion and transfer of resources and technology, as well as South-South collaboration, these successful examples will need to be examined and learned from. The identification of the necessary conditions for developing sustainable research, control efforts and health services will also be essential elements in the control of communicable diseases.

Investment in Health Research
Recently there has been growing interest in the study of how priorities for investment in health research are established in different parts of the world (16). There are a number of perspectives from which an analysis of these issues can be carried out, including a focus on the economic, health or human rights aspects of priority setting. In economic terms, there has been an increase in investment in health research, from 30 billion USD in 1990 (24) to 73.5 billion USD in 2001 (25). The health sector generates trillions of dollars at the global level; among the products and services to be invested in are prevention of disease and health promotion, as well as diagnosis and treatment. The World Bank is the agency that provides the largest amount of health-related financing worldwide, at close to one billion USD each year. The World Bank’s principal health-related aims are to contribute to the improvement of the health of the poor and to the reduction of the impoverishing effects of disease, as well as increasing equitable access to health care and promoting sustainable financing for health systems (26). The 1.3 billion USD provided by the World Bank for the fight against HIV/AIDS in recent years constitutes an example of how the emergence of a public health problem—specifically an emerging disease—can lead to the creation of new investment priorities in terms of health research, prevention activities and treatment.

Human development can be measured through three critical indicators: education, income and life expectancy, all of which interact in complex ways with health. The large North-South differences can be expressed in terms of these four elements and their reciprocal influences. These indicators would seem to indicate a lack of equity in the way health research priorities are established, which in turn translate into insufficient North-South transfer of applicable
health research results, technology and health investment. Among the many reasons offered to explain this situation is that in rich countries most infectious diseases are not endemic, as opposed to the reality of many poor countries, where emerging infections (such as HIV/AIDS) and re-emerging diseases (such as malaria, tuberculosis or cholera) are priority public health issues (see Box 4). Perhaps the most heart-wrenching example of this is the fact that epidemiologic surveillance and especially therapeutic interventions for HIV/AIDS are not available in poorer countries, where the large majority of people living with the disease are concentrated (90% of people living with HIV/AIDS reside in developing countries, and only 4% of the 6 million people living with the disease in resource poor areas received antiretroviral treatment in 2002 (27).

Conclusions

A communicable disease has been controlled if through public policy the spread of an infectious agent is restricted to its pre-epidemic status, which is to say that the epidemic has been reversed. On the other hand, a communicable disease is eliminated if it is sufficiently controlled to prevent the occurrence of an epidemic in a specific geographic area. Control and elimination are achieved locally, but a disease is eradicated only if it has been eliminated in all geographic regions.

Thus, eradication is clearly the most difficult goal to achieve, although it has large advantages over control. The economic effects of eradication can be extremely favorable in that it not only reduces the infection but also eliminates the need for future vaccination efforts. Eradication generally becomes feasible, from an economic point of view, when a disease is first eliminated in one or more of the richer countries. The incentives for participation by the poorer countries in eradication initiatives begin with the existence of an international control program, which allows them to take advantage of financial support for elimination efforts (28).

To promote and facilitate participation by developing and developed countries in epidemiologic surveillance systems, as well as initiatives for the control, elimination or eradication of communicable diseases, poor countries need to develop their capacity for early detection, dissemination of precise and high quality information and a high degree of transparency (29). All countries should adhere to international regulations, including the International Health Regulation and those of the World Trade Organization. Finally, developed countries should provide financial and technical support for countries undergoing emergencies linked to communicable diseases, because globally this is the only way they can guarantee the safety of their own populations and ensure the usefulness of their internal health-related investments. Ultimately, developed countries should also share expertise, technology, and funds as a contribution to social justice, because health is a fundamental human right.

References

1. Folch E, Hernandez I, Barragan M, Franco-Paredes C. Infectious diseases, non-zero-sum thinking, and the developing world. Am J Med Sci 2003;326:66–72.
2. Informe: III Reunión Conjunta de las Redes de Vigilancia de Enfermedades Infecciosas, Emergentes y Reemergentes. OPS-CDC. 2004. (Doc. OPS/DPC/CD/248/03 and Rev Med Trop 2004;33(Suppl 1): Jan–Jun).
3. Information consulted at: http://www.paho.org/English/AD/DPC/CD/networks.htm
4. Information consulted at: http://www.who.int/csr/outbreaknetwork/en/
5. Aginam O. International law and communicable diseases. Bull WHO 2002;80:946–951.
6. OPS Ahora: El boletín de la Organización Panamericana de la Salud, noviembre, 2004 (available at http://www.paho.org/English/AD/DPC/CD/opsahora_nov04.pdf)
7. EID Updates: Emerging and Reemerging Infectious Diseases, Region of the Americas 2004;2(24) (available at http://www.paho.org/English/AD/DPC/CD/eid-eer-2004-aug-12.htm)
8. EID Weekly Updates: Emerging and Reemerging Infectious Diseases, Region of the Americas, 2004;2(22) (available at http://www.paho.org/English/AD/DPC/CD/eid-eer-01-jul-2004.htm)
9. EID Weekly Updates: Emerging and Reemerging Infectious Diseases, Region of the Americas 2004;2(16) (available at http://www.paho.org/English/AD/DPC/CD/eid-eer-22-apr-2004.htm)
10. Weekly epidemiological record/Relevé épidémiologique hebdomadaire, 2002;46:381–388. (available at: http://www.who.int/wer)
11. Information consulted at: http://www.who.int/csr/don/2005_03_17/en/index.html
12. Information consulted at: http://www.who.int/csr/don/2002_08_13a/en/index.html
13. Gostin LO. International infectious disease law: revision of the World Health Organization’s International Health Regulations. JAMA 2004;291:2623–2627.
14. Buss PM. Globalization and disease: in an unequal world, unequal health. Cad Saude Publica 2002;18:1783–1788.
15. Orne-Gliemann J, Perez F, Leroy V, Newell ML, Dabis F. A decade of child health research in developing countries. Santé 2003;13:69–75.
16. Shiffman J, Beer T, Wu Y. The emergence of global disease control priorities. Health Policy Plan 2002;17:225–234.
17. Kaul I, Faust M. Global public goods and health: taking the agenda forward. Bull WHO 2001;79:869–874.
18. Aylward RB, Acharya A, England S, Agocs M, Linkins J. Global health goals: lessons from the worldwide effort to eradicate poliomyelitis. Lancet 2003;362:909–914.
19. Segall M. District health systems in a neoliberal world: a review of five key policy areas. Int J Health Plan Manage 2003;18(Suppl 1):S5–S26.
20. Smith R, Woodward D, Acharya A, Beaglehole R, Drager N. Communicable disease control: a ‘Global Public Good’ perspective. Health Policy Plan 2004;19:271–278.
21. Brugha R, Walt G. A global health fund: a leap of faith? BMJ 2001;323:152–154.
22. Gwatkin DR, Guillot M, Heuveline P. The burden of disease among the global poor. Lancet 1999;354:586–589.
23. Varmus H, Klausner R, Zerhouni E, Acharya T, Daar AS, Singer PA. Public health. Grand challenges in global health. Science 2003;302:398–399.
24. Commission on Health Research for Development. Health Research: Essential Link to Equity in Development. New York: Oxford University Press;1990.
25. Global Forum for Health Research. Monitoring Financial Flows for Health Research. Geneva: Global Forum for Health Research;2001.
26. Wagstaff A. Economics, health and development: some ethical dilemmas facing the World Bank and the international community. J Med Ethics 2001;27:262–267.
27. UNAIDS/WHO. Resumen mundial de la epidemia del VIH/SIDA: diciembre de 2002. Geneva: UNAIDS/WHO;2002.
28. Barrett S. Eradication versus control: the economics of global infectious disease policies. Bull WHO 2004;82:683–688.
29. Cash RA, Narasimhan V. Impediments to global surveillance of infectious diseases: consequences of open reporting in a global economy. Bull WHO 2000;78:1358–1367.
30. Information consulted at: http://www.who.int/csr/outbreaknetwork/en/
31. Jiang S, He Y, Liu S. SARS vaccine development. Emerg Infect Dis 2005;11(7) [serial on the Internet, cited 2005 Jul 1st. Available from http://www.cdc.gov/ncidod/EID/vol11no07/05-0219.htm]
32. Information consulted at http://www.who.int/csr/outbreaknetwork/en/