Global Public Health and Biosecurity: Managing Twenty-First Century Risks

Coping with Crisis

Working Paper Series

Margaret E. Kruk

July 2007

International Peace Academy

About the Author

Margaret E. Kruk is Lecturer in Health Management and Policy at the University of Michigan School of Public Health, Department of Health Management and Policy. She is also a consultant to the Averting Maternal Death and Disability Project at Columbia University and the United Nations. Previously, she was Policy Advisor for Health at the Millennium Project, an advisory body to the UN Secretary-General on the Millennium Development Goals. Dr. Kruk holds an MD from McMaster University and an MPH (Health Policy and Management) from Harvard University.

Acknowledgements

IPA owes a great debt of thanks to its many donors to *Coping with Crisis*. Their support for this Program reflects a widespread demand for innovative thinking on practical solutions to international challenges. In particular, IPA is grateful to the Governments of Australia, Belgium, Canada, Denmark, Finland, Greece, Luxembourg, the Netherlands, Norway, Spain, Sweden, and the United Kingdom. This Working Papers Series would also not have been possible without the support of the Greentree Foundation, which generously allowed IPA the use of the Whitney family's Greentree Estate for a meeting of the authors of these papers at a crucial moment in their development in October 2006.

The author would like to thank the staff of IPA, especially James Cockayne and Francesco Mancini, for their helpful comments on earlier drafts of this paper. She would also like to thank Katherine Kruk for her input on the initial outline and Christine Aguiar for her invaluable assistance with copyediting the paper. Thanks also to Sandro Galea for his generous support.

Cover Photo: Shelves full of medicines. ©ER Productions/Corbis.

Project Staff, *Coping with Crisis* Working Paper Series
Elizabeth Cousens, *Vice-President*
James Cockayne, *Associate*
Francesco Mancini, *Associate*
Naureen Chowdhury Fink, *Program Officer*

IPA Publications
Adam Lupel, *Editor/Publications Officer*

Design by Andrew Nofsinger. www.andrewnofsinger.com

www.ipacademy.org

CONTENTS

Foreword

Terje Rød-Larsen
President, International Peace Academy

The International Peace Academy (IPA) is pleased to introduce a new series of Working Papers within the program *Coping with Crisis, Conflict, and Change: The United Nations and Evolving Capacities for Managing Global Crises*, a four-year research and policy-facilitation program designed to generate fresh thinking about global crises and capacities for effective prevention and response.

In this series of Working Papers, IPA has asked leading experts to undertake a mapping exercise, presenting an assessment of critical challenges to human and international security. A first group of papers provides a horizontal perspective, examining the intersection of multiple challenges in specific regions of the world. A second group takes a vertical approach, providing in-depth analysis of global challenges relating to organized violence, poverty, population trends, public health, and climate change, among other topics. The Working Papers have three main objectives: to advance the understanding of these critical challenges and their interlinkages; to assess capacities to cope with these challenges and to draw scenarios for plausible future developments; and to offer a baseline for longer-term research and policy development.

Out of these initial Working Papers, a grave picture already emerges. The Papers make clear that common challenges take different forms in different regions of the world. At the same time, they show that complexity and interconnectedness will be a crucial attribute of crises in the foreseeable future.

First, new challenges are emerging, such as climate change and demographic trends. At least two billion additional inhabitants, and perhaps closer to three billion, will be added to the world over the next five decades, virtually all in the less developed regions, especially among the poorest countries in Africa and Asia. As a result of climate change, the magnitude and frequency of floods may increase in many regions; floods in coastal Bangladesh and India, for example, are expected to affect several million people. The demand for natural resources—notably water—will increase as a result of population growth and economic development; but some areas may have diminished access to clean water.

Second, some challenges are evolving in more dangerous global configurations such as transnational organized crime and terrorism. Illicit and violent organizations are gaining increasing control over territory, markets, and populations around the world. Non-state armed groups complicate peacemaking efforts due to their continued access to global commodity and arms markets. Many countries, even if they are not directly affected, can suffer from the economic impact of a major terrorist attack. States with ineffective and corrupted institutions may prove to be weak links in global arrangements to deal with threats ranging from the avian flu to transnational terrorism.

Finally, as these complex challenges emerge and evolve, "old" problems still persist. While the number of violent conflicts waged around the world has recently declined, inequality—particularly between groups within the same country—is on the rise. When this intergroup inequality aligns with religious, ethnic, racial and language divides, the prospect of tension rises. Meanwhile, at the state level, the number of actual and aspirant nuclear-armed countries is growing, as is their ability to acquire weapons through illicit global trade.

As the international institutions created in the aftermath of World War II enter their seventh decade, their capacity to cope with this complex, rapidly evolving and interconnected security landscape is being sharply tested. The United Nations has made important progress in some of its core functions—"keeping the peace," providing humanitarian relief, and helping advance human development and security. However, there are

reasons to question whether the broad UN crisis management system for prevention and response is up to the test.

Not only the UN, but also regional and state mechanisms are challenged by this complex landscape and the nature and scale of crises. In the Middle East, for example, interlinked conflicts are complicated by demographic and socioeconomic trends and regional institutions capable of coping with crisis are lacking. In both Latin America and Africa, "old" problems of domestic insecurity arising from weak institutions and incomplete democratization intersect with "new" transnational challenges such as organized crime. Overall, there is reason for concern about net global capacities to cope with these challenges, generating a growing sense of global crisis.

Reading these Working Papers, the first step in a four-year research program, one is left with a sense of urgency about the need for action and change: action where policies and mechanisms have already been identified; change where institutions are deemed inadequate and require innovation. The diversity of challenges suggests that solutions cannot rest in one actor or mechanism alone. For example, greater multilateral engagement can produce a regulatory framework to combat small arms proliferation and misuse, while private actors, including both industry and local communities, will need to play indispensable roles in forging global solutions to public health provision and food security. At the same time, the complexity and intertwined nature of the challenges require solutions at multiple levels. For example, governments will need to confront the realities that demographic change will impose on them in coming years, while international organizations such as the UN have a key role to play in technical assistance and norm-setting in areas as diverse as education, urban planning and environmental control.

That the world is changing is hardly news. What is new is a faster rate of change than ever before and an unprecedented interconnectedness between different domains of human activity—and the crises they can precipitate. This series of Working Papers aims to contribute to understanding these complexities and the responses that are needed from institutions and decision-makers to cope with these crises, challenges and change.

Terje Rød-Larsen

Introduction

In this first decade of the twenty-first century, we have reason both to commend and to decry the state of human health and our ability to improve it. We have achieved a maximum life expectancy of eighty-six years and have found a way to manage, though not cure, the most deadly epidemic since the Black Plague, AIDS.[1] We can keep up with mutating viruses to produce a new flu vaccine every year and we can save babies born only twenty-three weeks into a pregnancy. Yet that is only half the picture. We also live in a world where a Nigerian newborn has a nearly one in five chance of dying before reaching age five and her mother a one in sixteen chance of dying in one of her pregnancies. Life expectancy in parts of sub-Saharan Africa has fallen below forty years. We have experienced remarkable scientific advances over the past fifty years, although we have not been able to apply many of these to the bedside or to public health policy. And so we have powerful genetic tools to study the components of viral RNA but cannot predict when or even if the bird flu will spread to humans.

The fault lines between the health of the rich and poor and between what we know and how we can use that knowledge contribute to creating a pervasive sense of global health insecurity. The links between health and political stability were recognized by the United Nations High Level Panel on Threats, Challenges and Change, which named the overwhelming disease burden in developing countries in the context of dysfunctional public health systems one of the six major threats to global security (High-Level Panel on Threats, Challenges and Change 2004). Just as health and disease do not respect national boundaries, so too, the response demands the concerted efforts of the international community and particularly of multilateral institutions. The focus of this paper is on the role of global public health systems and actors in enhancing biosecurity—which for this paper will be broadly defined as the collective activities that mitigate the risks to human health and survival.

Current Status of Human Health

Overview of Global Disease Burden

Table 1 shows the major causes of death in the world. Chronic diseases, ischemic heart disease, and cerebrovascular disease top the list. These diseases are associated with aging, a natural process, but are at the same time exacerbated by lifestyle choices. Some important contributors to global mortality, like diabetes, do not appear on the list because they kill indirectly, in the case of diabetes through cardiovascular disease. Diabetes as a root cause is estimated to

Top causes of death, 2002

Disease	Percent
Ischemic heart disease	12.6
Cerebrovascular disease	9.6
Lower respiratory infections	6.6
HIV / AIDS	4.9
Chronic obstructive pulmonary disease	4.8
Perinatal conditions	4.3
Diarrheal diseases	3.1
Tuberculosis	2.8
Trachea, bronchus, lung cancers	2.2
Malaria	2.1

Source: Mathers, CD, C Bernard, K Moesgaard Iburg, M Inoue, D Ma Fat, K Shibuya, C Stein, N Tomijima, and H Xu. "Global Burden of Disease in 2002: data sources, methods and results." Geneva World Health Organization, 2003.

Table 1

[1] The life expectancy of eighty-six years is used in reference to Japanese women.

be responsible for up to four million deaths or 9 percent of total deaths. In a perfectly equitable world, chronic diseases that cannot be cured would dominate the list of top ten killers—but we find curable conditions on this list too. Lower respiratory infections, diarrheal disease, tuberculosis (TB), malaria, and some perinatal conditions can be cured and/or prevented with today's technologies, yet, combined they take over 18 percent of lives lost. Many of these treatable causes of death affect the youngest: over ten million of the fifty-seven million people who died in 2002 were children under five (WHO 2003b).

The concept of burden of disease is an attempt to weigh the relative contribution of various diseases and conditions to human death and disability. Burden of disease is often measured in number of disability-adjusted life years lost (or DALYs) — years of life spent in less than perfect health, with different weights for diseases of different severities. Some diseases do not kill but their high incidence or duration prevents large numbers of people from living a fully productive and meaningful life. These diseases thus contribute to the burden of disease but do not feature as top killers.

Table 2 lists the top ten causes of burden of disease and injury. Thus, unipolar depression and road traffic accidents are key public health concerns as they disable large numbers of people. Chronic diseases such as diabetes, heart disease, and cerebrovascular disease are increasing rapidly with the aging of the population. The global prevalence of diabetes, for example, was estimated at 30 million in 1985, 177 million in 2000, and is expected to reach 300 million by 2025. Much of the growth will be in developing countries due to population growth and aging, as well as unhealthy diets and sedentary lifestyles (WHO 2006). Injuries and traffic accidents are also of increasing concern. Road traffic accidents kill 1.2 million people per year today and injure or disable 20 to 50 million more. By 2020, the death toll is expected to rise by 67 percent to make road traffic injuries the third largest contributor to the global burden of disease (WHO and World Bank 2004).

But not all threats to health are captured by top ten lists. Also of concern to biosecurity are diseases that have disproportionate impact on communities and economies or those that do not yet affect many people but are potential mass killers. Maternal mortality is an example of the former. Numerically, few women die in pregnancy or childbirth, yet their deaths destabilize families and communities.[2] The children of a woman who dies in pregnancy face much higher odds of dying themselves. Families break up because they are unable to cope with the loss of the primary caregiver and societies lose the economic contribution of women in their prime. Emerging diseases—whether caused by new microorganisms (AIDS, SARS), the evolution of known microorganisms (influenza), the new spread of known diseases

Top causes of burden of disease and injury, 2002

Disease / Injury	Percent of total DALYs
Perinatal conditions	6.5
Lower respiratory infections	5.8
HIV / AIDS	5.8
Unipolar depressive disorders	4.5
Diarrheal diseases	4.1
Ischemic heart disease	3.9
Cerebrovascular disease	3.3
Malaria	3.0
Road traffic accidents	2.6
Tuberculosis	2.4

Source: Mathers, CD, C Bernard, K Moesgaard Iburg, M Inoue, D Ma Fat, K Shibuya, C Stein, N Tomijima, and H Xu. "Global Burden of Disease in 2002: data sources, methods and results." Geneva World Health Organization, 2003.

Table 2

[2] Approximately 529,000 women die each year while pregnant, during delivery, or within forty-two days of delivery.

(West Nile virus), or the reemergence of old infections as a result of the loss of treatment effectiveness (drug-resistant TB)—loom large in the imagination of the public and the projections of health experts and economists. Non-health phenomena like natural and human-made disasters are a more common threat to physical and mental health than is commonly realized, with 15 percent of people living in the US experiencing a disaster in their lifetimes (Kessler et al. 1995).

The global public health community is rightly concerned with both established and emerging health challenges. But critical to responding to these challenges is to understand how they are distributed among, and within, populations. Disease does not strike all people equally and indeed, health systems do not treat people with the same illnesses equally. These inequities manifest themselves in strikingly different diseases and death rates, rates of access to health services, and financial burdens in paying for health care—both among countries and among people in the same country. While genetic differences and lifestyle choices account for some of this difference, the vast majority of ill health among disadvantaged groups (as manifested through wealth, gender, race, or ethnicity) is a result of inadequate access to the preconditions for health such as education and nutrition, unhealthy living or working conditions, and inadequate access to health services (Braveman and Gruskin 2003).

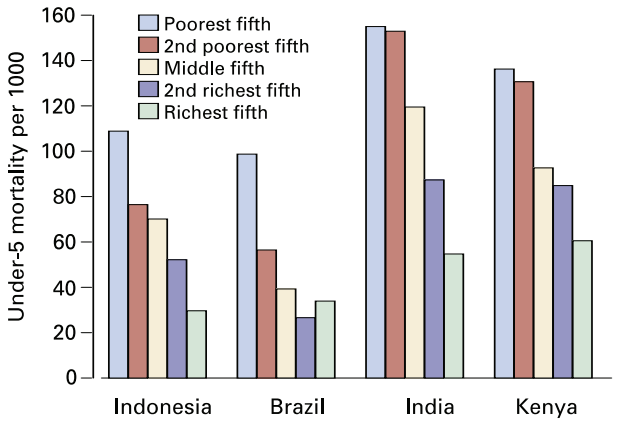
Life expectancy, an important measure of the overall health of the population, and by extension its many determinants, demonstrates the first major cleavage in global health status—the differences between rich and poor countries. In sub-Saharan Africa and parts of Asia, the average baby born in the 1990s would not live beyond fifty-five years of age—and in many countries not even beyond forty—while a baby born in western Europe or North America could expect to live seventy years or more.

Maternal mortality is nearly hundredfold greater in some African countries than in the industrialized world (Ronsman and Graham 2006). The impact of poverty on health outcomes can also be demonstrated by inequalities within countries, with the poorest 20 percent of households in some countries having twice the under-five mortality rates of the wealthiest group in the same country (see Figure 1) (Victora et al. 2003).

As discussed above, children under five (especially newborns) remain extremely vulnerable to infectious diseases, the vast majority of which are preventable and/or curable. Yet children in poor countries, and especially the poorest children in those countries, do not receive the benefits of the knowledge and technologies routinely available to children in rich countries. We know that while the poor in general have greater health needs, they also receive the fewest medical services—sometimes called the inverse-care law (Hart 1971). Figure 2 shows how access to basic health services varies by income in over 50 developing and transitional countries.

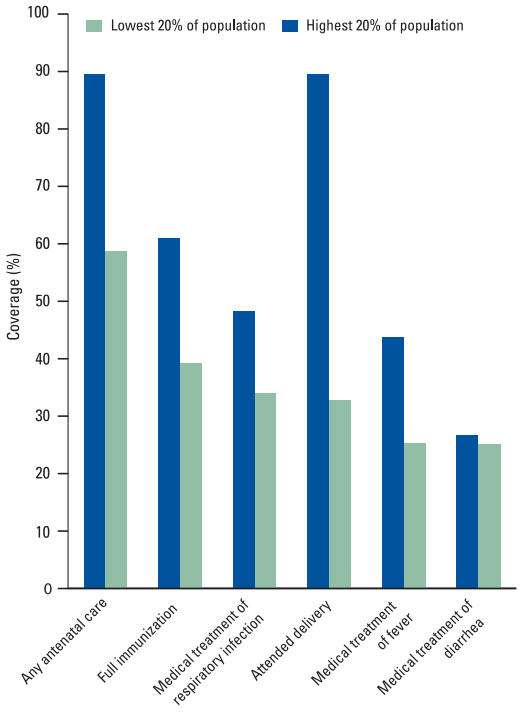
Another point of inequity is gender, with women being uniquely exposed to, or at higher risk of,

Under-five mortality rates by socioeconomic quintile of the household for selected countries



Source: Victora, CG, A Wagstaff, JA Schellenberg, Davidson R Gwatkin, M Claeson, and JP Habicht. "Applying an Equity Lens to Child Health and Mortality: More of the Same Is Not Enough." *The Lancet* 362 (2003): 233-41.

Figure 1



Source: Gwatkin, D. R., A. Bhuiya, and C. G. Victora. "Making Health Systems More Equitable." *Lancet* 364, no. 9441 (2004): 1273-80.

Figure 2

specific health threats from maternal mortality to HIV/AIDS (in Africa) to domestic violence. Between 10 and 69 percent of women in all countries with reliable data report being physically abused by an intimate partner (WHO 2001). Lastly, ethnicity or race is in many countries a powerful predictor of health status and outcomes, a relationship partly mediated by income and partly by lack of access to power and the resulting differential treatment by the health system. This can be seen in rich and poor countries alike. Table 3 shows infant mortality and low birth weight ratios for black and white Americans, with rates of both among blacks at least twice as high as among whites (Centers for Disease Control and Prevention 2002).

Many of these health disparities among countries are even more worrying in light of time trend data. Before 1980, life expectancies were expected to continue to rise everywhere; indeed reversals in mortality decline were rarely seen outside of war and famine. However, in the 1980s and 1990s, the AIDS epidemic caused life expectancies to fall in sub-Saharan Africa, in some countries by twenty years. Life expectancies also fell in the countries of the former Soviet Union—a result of increasing adult deaths due to heart disease, alcohol-related illness, and violence, within a context of declining social conditions and deteriorating public health systems (McMichael

Infant mortality*, low birth weight†, and very low birth weight§ rates and ratios¶ among black and white births, by year—United States, 1980–2000

Year	Infant mortality				Low birth weight				Very low birth weight			
	Black	White	Ratio	All races	Black	White	Ratio	All races	Black	White	Ratio	All races
1980	22.2	10.9	2.0	**12.6**	12.7	5.7	2.2	**6.8**	2.48	0.90	2.76	**1.15**
1981	20.8	10.3	2.0	**11.9**	12.7	5.7	2.2	**6.8**	2.52	0.91	2.74	**1.16**
1982	20.5	9.9	2.1	**11.5**	12.6	5.6	2.3	**6.8**	2.56	0.91	2.73	**1.18**
1983	20.0	9.6	2.1	**11.2**	12.8	5.7	2.2	**6.8**	2.60	0.92	2.74	**1.19**
1984	19.2	9.3	2.1	**10.8**	12.6	5.6	2.3	**6.7**	2.60	0.93	2.78	**1.19**
1985	19.0	9.2	2.1	**10.6**	12.6	5.7	2.2	**6.8**	2.71	0.93	2.72	**1.21**
1986	18.9	8.8	2.1	**10.4**	12.8	5.7	2.2	**6.8**	2.73	0.93	2.86	**1.21**
1987	18.8	8.5	2.2	**10.1**	13.0	5.7	2.2	**6.9**	2.79	0.94	2.90	**1.24**
1988	18.5	8.4	2.2	**10.0**	13.3	5.7	2.3	**6.9**	2.86	0.93	3.08	**1.24**
1989	18.6	8.1	2.3	**9.8**	13.5	5.7	2.4	**7.0**	2.95	0.95	3.11	**1.28**
1990	18.0	7.6	2.4	**9.2**	13.3	5.7	2.3	**7.0**	2.92	0.95	3.07	**1.27**
1991	17.6	7.3	2.4	**8.9**	13.6	5.8	2.3	**7.1**	2.96	0.96	3.08	**1.29**
1992	16.8	6.9	2.4	**8.5**	13.3	5.8	2.3	**7.1**	2.96	0.96	3.08	**1.29**
1993	16.5	6.8	2.4	**8.4**	13.3	6.0	2.2	**7.2**	2.96	1.01	2.93	**1.33**
1994	15.8	6.6	2.4	**8.0**	13.2	6.1	2.2	**7.3**	2.96	1.02	2.90	**1.33**
1995	15.1	6.3	2.4	**7.6**	13.1	6.2	2.1	**7.3**	2.97	1.06	2.80	**1.35**
1996	14.7	6.1	2.4	**7.3**	13.0	6.3	2.1	**7.4**	2.99	1.09	2.74	**1.37**
1997	14.2	6.0	2.4	**7.2**	13.0	6.5	2.0	**7.5**	3.04	1.13	2.69	**1.42**
1998	14.3	6.0	2.4	**7.2**	13.0	6.5	2.0	**7.6**	3.08	1.15	2.68	**1.45**
1999	14.6	5.8	2.5	**7.1**	13.1	6.6	2.0	**7.6**	3.14	1.15	2.73	**1.45**
2000**	14.0	5.7	2.5	**6.9**	13.0	6.5	2.0	**7.6**	3.07	1.14	2.69	**1.43**

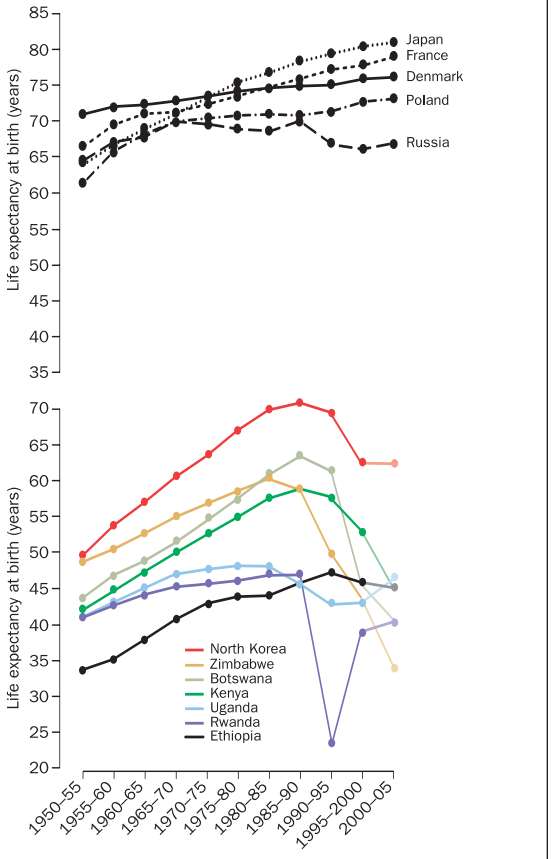
* Number of infants born alive who died within the first year of life per 1,000 live births. † <2,500 grams. § <1,500 grams. ¶ Ratio of black to white infant mortality. ** Preliminary data for infant mortality.

Source: Centers for Disease Control and Prevention. "Infant Mortality and Low Birth Weight among Black and White Infants—United States, 1980–2000." *MMWR* 51, no. 27 (2002): 589-92.

Table 3

2004). Figure 3 shows historic trends in life expectancy in selected developed and developing countries, demonstrating this historic reversal (McMichael 2004). Similarly in the United States, the black-white infant mortality gap increased between 1980 and 2000 (in Table 3).

The global picture in child health is also discouraging. Between 1970 and 2000, under-five mortality rates decreased 71 percent in high-income countries but only 40 percent in low-income countries where rates were much higher at baseline and so potentially more amenable to simple public health measures (Victora et al. 2003). Other health risks, including chronic diseases and injuries, will also take a disproportionate toll on developing countries. For example, road traffic deaths are expected to decrease by 27 percent in high-income countries as a result of effective policies and vehicle safety technologies but will increase by 83 percent in low-income and middle-income countries (WHO and World Bank 2004). Perhaps not surprisingly then, both the international health community and national governments are beginning to view equity in health as a critical goal in itself, separate and apart from the aggregate health status of the population. Concerted action is required to ensure that the benefits of health care and other determinants of health are extended more broadly across populations.



Source: McMichael, A.J. "Mortality Trends and Setbacks: Global Convergence or Divergence?" *Lancet* 363, no. 9415 (2004): 1155-9.

Figure 3

Gaps in Knowledge

Tackling the challenges to biosecurity requires overcoming two gaps—the knowledge gap and the "know-do" gap. The former is best exemplified by the search for the AIDS vaccine. It is a gap in existing technology needed to tackle a public health problem. The need for new knowledge is particularly urgent in the face of emerging health threats such as diseases caused by new or mutated pathogens like Ebola and severe acute respiratory syndrome (SARS). The second gap manifests as an inability to implement known solutions—be it due to a failure in translating knowledge into real world tools or the inability to implement those tools. The know-do gap is by far the major reason for the failure to address the inequity in health status and access to health care. For example, health experts have stated categorically that the Millennium Development Goals (MDGs) for health—a series of time-bound quantified targets for progress in health adopted by 190 countries in 2000—can all be reached with existing technologies and knowledge (UN Millennium Project 2005b).[3] Yet many countries are not on track to meet the MDGs. The following discussion reviews some of the current knowledge and know-do gaps in health.

In terms of individual level disease prevention and treatment, AIDS and malaria vaccines, even if only partially effective, would dramatically diminish the impact of these two major killers in Africa and elsewhere. A new malaria vaccine has shown promise in reducing severe malaria (the type most likely to kill) in several large trials in Africa, but is still years from being approved. Another key prevention technology needed is microbicides and other tools for HIV prevention, particularly those that can be controlled by women. With the centuries-old microscope still the gold standard for diagnosing TB, new diagnostic

[3] The health MDGs are the following: Goal 4, reduce child mortality by two-thirds; Goal 5, reduce maternal mortality by three-quarters; and Goal 6, combat HIV/AIDS, malaria, and other diseases by halting or reversing their spread. In addition, Target 17 of Goal 8 urges provision of access to affordable essential drugs in developing countries. All the targets have 1990 as the baseline and 2015 as the end year.

technologies are urgently needed. Rapid diagnostic tests, especially ones that can be used in the tropics, are needed not just for old foes like TB and malaria but also to maintain vigilance against the emergence of killer diseases like Ebola and to expedite the diagnosis of bio-terror pathogens. Cures for chronic diseases, including cancer, are still remote, but improved treatments, where dosing is simplified and side effects minimized, are gradually becoming available. New drugs are needed to fight infectious diseases that have developed resistance to older agents and to tackle new organisms that may emerge, like influenza (A) virus subtype H5N1, the "bird flu."

But at the same time we must dramatically accelerate our implementation of what we already know. For instance, short-term training of nurses and doctors complemented with a reliable drug supply and supportive supervision can dramatically improve the detection and proper treatment of common childhood diseases in developing countries (Tanzania IMCI Multi-country Evaluation Health Facility Survey Study Group 2004). A recent analysis found that we can prevent nearly two-thirds of child deaths by applying this and other proven child health interventions at scale (Jones et al. 2003). Similarly, maternal mortality can be significantly reduced by ensuring that all women have a skilled attendant at delivery, access to emergency obstetric care when needed, and access to safe abortions (UN Millennium Project 2005c). Yet today, in the context of underfunded and deteriorating public health systems found in developing countries, only half of the world's women have a skilled birth attendant at delivery and even fewer have access to emergency care. In 2006 only 1.3 million people with AIDS, or 1 in 5, received the highly effective treatment that allows them to resume a virtually normal life (UNAIDS 2006). In the management of chronic disease, where a range of treatment options exists, ensuring timely diagnosis and encouraging long-term adherence to these treatments present a major challenge.

As in individual health, new knowledge and better application of what is known are needed to better manage the health of populations. We need to understand how to prepare for, and mitigate, the effects of natural and human-made disasters. For example, we have not yet identified effective interventions to reduce the risk of psychiatric illness after disasters. While we know more about the genetic basis of obesity, we desperately lack effective approaches for changing behaviors (like diet and activity levels) that contribute to this growing health threat. Similarly, sexual behavior and smoking patterns are very difficult to impact.

Many questions also remain on how to manage health systems in order to deliver the best health care. Even where effective approaches have been identified, applying them throughout the health system can be a challenge. The Institute of Medicine (IOM) in the United States estimates that 1.5 million preventable adverse drug events, or drug errors, occurred in the US each year at a cost of at least $3.5 billion for hospital-based errors alone—this despite clear, proven strategies to reduce drug errors, such as electronic prescribing, improved labeling, and better patient-doctor communication about medicines (Institute of Medicine 2006).

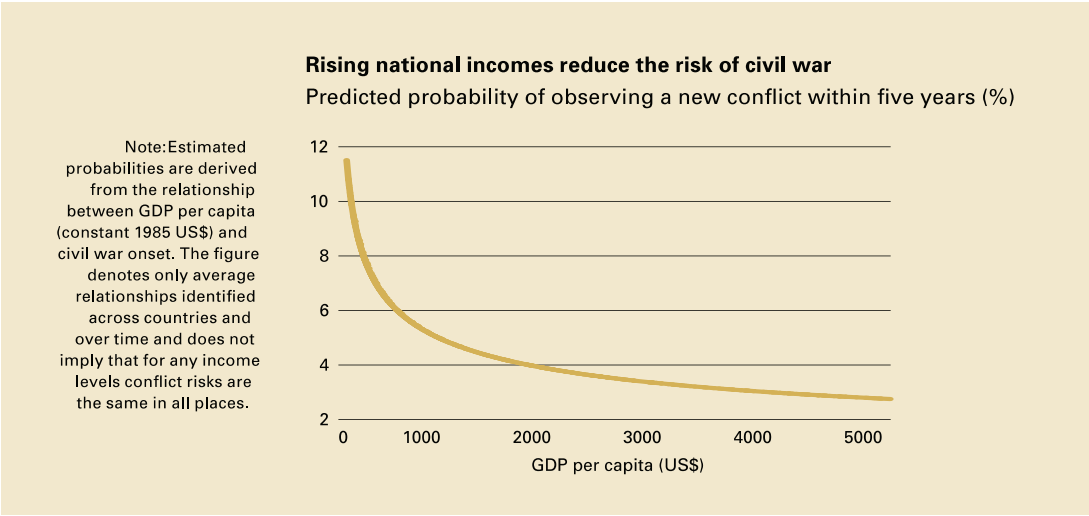
Future Risks to Health and Biosecurity

Challenges to Human Security in the Short- and Long-Term

Several aspects of health will pose substantial challenges to security in the coming decades. This non-exhaustive list includes the impact of high disease burden on the political, economic, and social stability of developing countries, the risks of resurgent and new diseases, the use of biological weapons by terrorists, and the displacement of other social investments by an increase in spending on health in rich countries.

Poverty in itself can be a threat to biosecurity, both as a consequence and a cause of ill health. Nowhere is this more starkly demonstrated than in sub-Saharan Africa where 46 percent of the population lives on less than $1 per day, the highest proportion of poverty in the world, and where the Millennium Development Goals for health are farthest from realization (UN Millennium Project 2005b). Poor countries and poor people within countries tend to have poor health outcomes—in large part because of inadequate investment in education, nutrition, and health care. Disease can also contribute to poverty by reducing productivity on the job and absenteeism from work. In particular, diseases that target economically productive age groups, like AIDS and TB, have a strong deleterious effect on national income in highly affected African countries. The International Labour Organization (ILO) estimates that economies of the most affected countries in sub-Saharan Africa could see an average annual reduction in their gross domestic product (GDP) growth rate of 0.5-4 percent, and that their 2020 GDP at current prevalence rates of HIV would be 18 percent lower

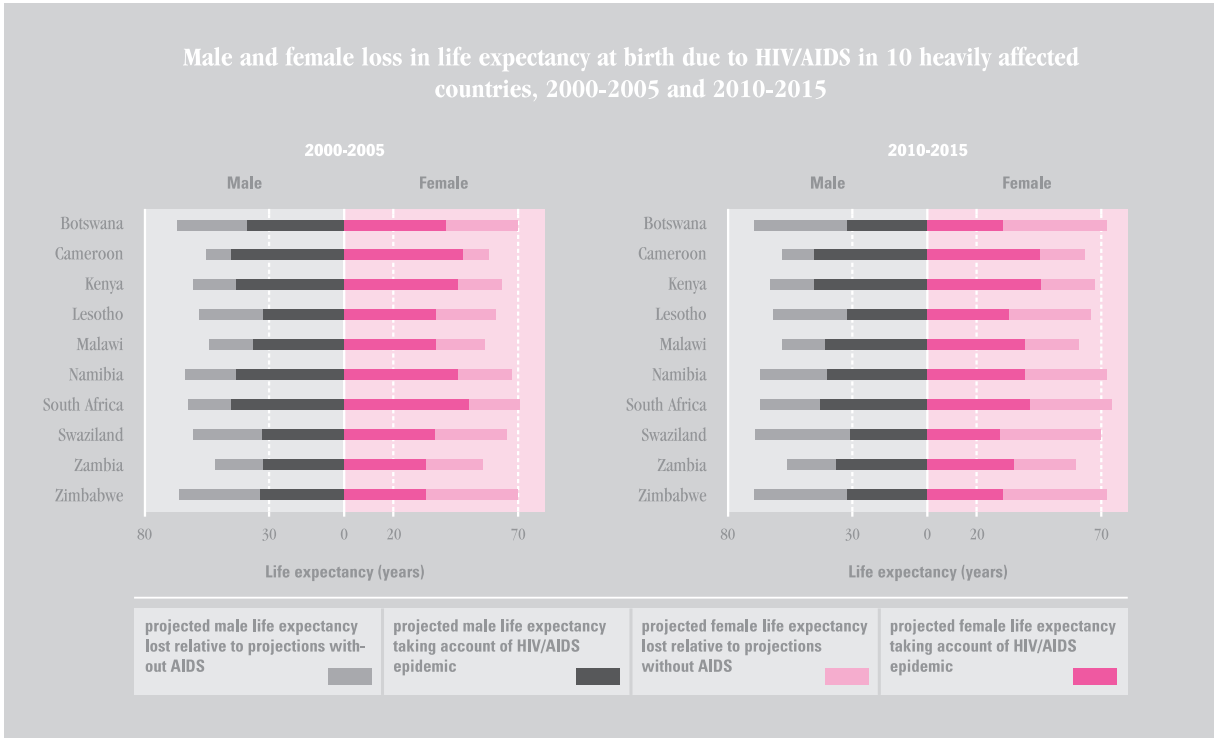
The poverty conflict nexus



Source: UN Millennium Project 2005. "Investing in Development: A Practical Plan to Achieve the Millennium Development Goals." New York: UNDP, 2005, p. 43.

Figure 4

Projected impact of AIDS on life expectancy in heavily affected African countries



Source: International Labour Office. "HIV/Aids and Work: Global Estimates, Impact and Responses." Geneva: International Labour Office, 2004.

Figure 5

than without AIDS—a loss of $144 billion over the period (International Labour Office 2004). Similarly, malaria has been estimated to reduce Africa's GDP growth by 1.3 percent each year (Sachs and Malaney 2002). Therefore, if unchecked, the high disease burden will slow or halt development in parts of Africa, consigning millions on the continent to unrelenting poverty.

Poverty is in turn associated with conflict. In the longer run, perhaps in twenty or thirty years, regional and perhaps global peace and stability may be undermined by the vast poverty and glaring differences in health and economic opportunity between the haves and have-nots in places like sub-Saharan Africa. Countries with incomes of only $500 per capita are twice as likely to have a major conflict within five years as countries with incomes of $4,000 per capita (Figure 4) (UN Millennium Project 2005b). The average per capita income in sub-Saharan Africa in 2002 was $577 (World Bank 2006c). While the mechanisms for this association are not clear, a combination of poverty, inequality, and existing social cleavages seems to predispose countries to conflict.[4] The declining life expectancy in the region may also contribute to creating the conditions for conflict (Figure 5). Such a fall in life expectancy alters the balance of the population in favor of the young. The "youth bulge," in combination with poor economic growth, has been found to be especially potent in instigating conflict (Urdal 2004).[5]

Another threat to health and biosecurity more broadly is that posed by new or resurgent diseases. These include AIDS, SARS, Ebola, Hantavirus, and avian flu, as well as drug-resistant infections like multi-drug resistant TB or methicillin resistant staphylococcus aureus (MRSA or "flesh eating" staphylococcus). These are perhaps the most vivid health issues in the minds of the public—and among the only health threats to regularly make the front pages of newspapers. That said, their estimated potential impact is highly variable. On the one hand are extremely lethal though rare diseases: the Ebola and Marburg viruses, found in rainforests of Africa and the Western Pacific, cause death in 50-90 percent of symptomatic individuals and are readily transmitted through bodily fluids; no treatment or vaccine exists. However, for a host of poorly-understood ecologic reasons, only 1,850 cases and 1,200 deaths have occurred from Ebola and fewer from Marburg since the viruses were first identified in 1976 and 1967, respectively (WHO 2006). Drug resistant diseases are perhaps a greater public health concern given their inexorably upward trajectory, sparked by improper use or overuse of existing drugs. For example, multi-drug resistant TB has been documented in most countries of the world.[6] While there are still drugs available to treat this form of TB, treatment is on average a hundred times more expensive than treating regular TB, is more toxic to the patient, and takes up to two years (WHO 2006). MRSA, which in the mid-1980s was limited to large urban hospitals and had an overall prevalence of 5-10 percent, can now be found in up to 50 percent of intensive care units (Chambers 2001). There are two drugs left today that can cure most strains of MRSA, but new drugs are urgently needed. In terms of new organisms, the 2004 SARS outbreak in East Asia killed 800 people and caused massive economic losses, estimated at 0.5 percent of the annual East Asian GDP, as people tried to minimize face-to-face contact and avoided mass transportation, shops, hotels and restaurants (World Bank 2006). Future outbreaks are likely.

The emerging disease with perhaps the highest potential risk to biosecurity is avian influenza. The World Health Organization (WHO) and other expert groups agree that influenza virus H5N1, which has already totaled more than $10 billion in direct economic costs in Asia, largely through losses to the poultry industry, has the potential to mutate to a form capable of causing a worldwide pandemic. H5N1, which has only crossed the species barrier to humans a handful of times, has a case fatality rate of over 50 percent. If the transmissibility of H5N1 improves among humans, even if the new virus causes a mild form of the flu, the resulting pandemic could take from 2-7.4 million lives globally. If the virus is more virulent, resembling the Spanish flu of 1918 for example, which itself was caused by a mutated avian flu virus, the deaths could number in the region of 150 million (World Bank 2006, WHO 2006).[7] These high numbers are in part explained by the fact that no H5N1 virus has ever circulated among (and thus conferred resistance to) humans, leaving the entire

[4] See Ravi Kanbur, "Poverty and Conflict: The Inequality Link," *Coping with Crisis* Working Paper Series, International Peace Academy, New York, June 2007.

[5] On the geographical distribution of coming youth bulges, see Joseph Chamie, "Population Trends: Humanity in Transition," *Coping with Crisis* Working Paper Series, International Peace Academy, New York, June 2007.

[6] TB bacilli resistant to isoniazid and rifampicin, the two most potent drugs available for TB treatment.

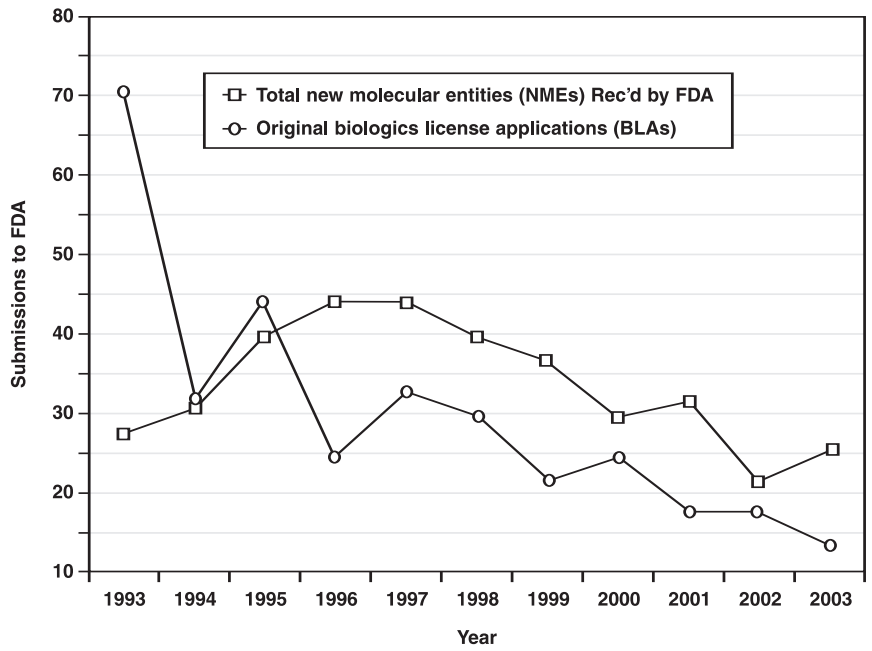
[7] The large variation in projections is due to different assumptions about mortality rates in mild versus more severe flu epidemics. The lower bound estimates are based on the relatively mild flu of 1967, while the high estimate is based on the highly virulent flu of 1918.

world population vulnerable to infection. In bird flu, infection is spread before symptoms emerge, further complicating control efforts. While the effectiveness of available antiviral drugs for H5N1 is still not clear, the WHO is urging countries to stockpile antiviral drugs like Tamiflu and is itself stockpiling 3 million doses for emergency assistance to countries. Research into a H5N1 vaccine is under way but because a vaccine must match the exact virus infecting humans, mass production of any vaccine could only begin once a pandemic has occurred—and likely several months into it. To compound the problem, current global production is far below the expected need in the event of a pandemic (WHO 2006). The WHO notes that H5N1 has now become endemic in Asian poultry, where high population density in close proximity to the birds increases the chances of genetic reassortment that could turn it into a major threat to humans (WHO 2005).

Bioterrorism is another area of concern. While most biologic agents are either difficult to disseminate broadly or are not especially deadly, a number of easily spread, toxic agents exist. Among these are anthrax, smallpox, botulin, plague, and tularemia. Ebola and Marburg viruses could also theoretically be used by terrorists. Anthrax and smallpox have perhaps the largest potential for mass loss of life and maximum social disruption. They are highly lethal; for example, the death rates for anthrax are 80 percent even before the onset of serious symptoms. Both the agents are stable in an aerosol form and can be mass-produced. Vaccines are limited and requirements for treatment in the case of a bioterror attack could easily overwhelm public health systems (Kortepeter and Parker 1999). Thus far, bioterrorist attacks have been rare and have caused few casualties. The most prominent recent cases include the 2001 anthrax attacks in the US and the 2003 ricin incident in which letters containing ricin were sent to US government officials. These incidents affected few people directly but shut down post offices and government buildings and inspired widespread fear—pointing out that the psychological aspects of bioterrorism may be far greater than their direct impact on health (WHO 2004). The economic impact of a bioterror attack can be large. Experts estimate that an attack involving anthrax could cost $26.2 billion per 100,000 persons exposed (Khardori 2006). While the impact of such agents has been limited to date, the risks appear to be growing: the number of states experimenting with biological weapons has increased from four to eleven between the 1960s and the 1990s. Five of the seven countries classified by the US Department of State as sponsors of terrorism may have biological weapon programs (Khardori 2006). Widespread availability of information on bioterror agents and their production, coupled with growing access to the agents in research institutions and the relative ease of transport, raise the risk that non-state actors such as terrorist groups will access and release the agents, as several have done in the past (Kortepeter and Parker 1999).

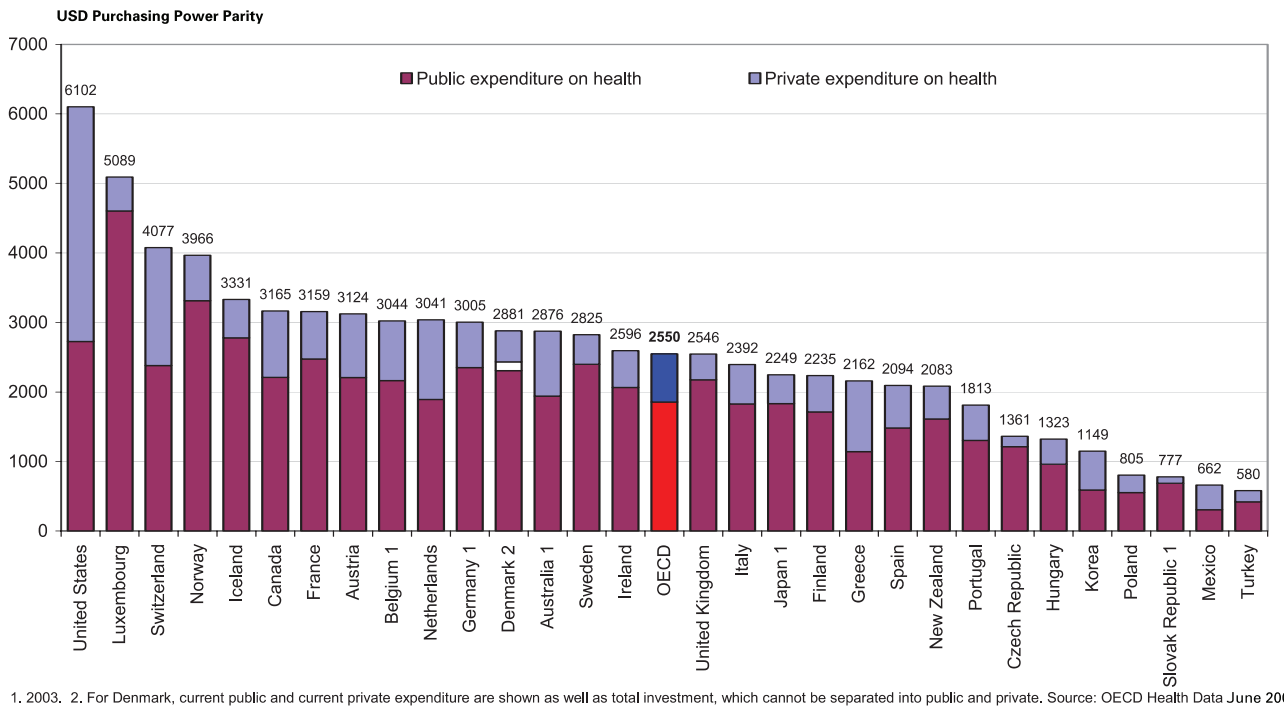
Addressing the challenges posed by emerging diseases will require new therapies and diagnostics. Pharmaceutical innovation will also be urgently needed to boost our efforts in fighting diseases that contribute most to the global burden. Yet drug research has not kept pace with the need. The two manifestations of this are the huge disparity between the focus of research spending and actual disease burden and the overall lack of innovation in research. In a ground-breaking 1990 report, the Global Forum for Health Research estimated that of the approximately $30 billion spent globally on health research and development (R&D) each year, only 10 percent was being spent on 90 percent of the world's health problems (the "10/90 gap"), largely the diseases of the developing world (Global Forum for Health Research 2005). For example, even as TB continues to kill up to 2 million people per year, no new drugs have been developed for the disease in the last fifty years. While health research spending rose to $105.9 billion in 2001, the size of the gap between spending and need stayed roughly the same. About half of global R&D spending comes from private industry and nearly half of that comes from the United States (Global Forum for Health Research 2004). The market orientation of much of the pharmaceutical industry means that there is little incentive to invest in new drugs for diseases of poor countries where governments and individuals cannot afford to pay the high prices that drive pharmaceutical profits.

On the innovation front, the US Food and Drug Administration (FDA) has recently noted that there were many fewer applications for drugs with a novel chemical structure (as contrasted with drugs with a similar structure or "me-too" drugs) and for new biological agents in 2003 than there were in 1993 and the slope of the decline has been particularly steep since 1997 (see Figure 6). This is despite the genomics revolution that promised to accelerate research and development of new products. The FDA blames this slowdown, which appears to be mirrored in other countries, on the obsolescence of the current drug development process. Essentially, the lengthy and cumbersome testing process for new drugs has not evolved over the years, even as substantial advances



Source: Food and Drug Administration. "Innovation or Stagnation—Challenge and Opportunity on the Critical Path to New Medical Products." Bethesda, Maryland: Food and Drug Administration, 2004.

Figure 6



1. 2003. 2. For Denmark, current public and current private expenditure are shown as well as total investment, which cannot be separated into public and private. Source: OECD Health Data June 2006.

Source: Organization for Economic Cooperation and Development. 2006. Rising Health Costs Put Pressure on Public Finances, Finds Oecd. In, http://www.oecd.org/document/37/0,2340,en_2649_37407_36986213_1_1_1_37407,00.html. (accessed July 10, 2006).

Figure 7

have been made in the basic sciences. Indeed, promising new compounds are increasingly more, not less, costly to test and bring to market. The investment required to bring one drug from discovery to successful launch in 2000-2002 was estimated at $1.7 billion, up 55 percent from the previous period of 1995-2000 (Food and Drug Administration 2004). Combined, the dissonance between production of new drugs and global need and the relative lack of novel drugs threatens our ability to respond to old and new health challenges.

A more indirect risk to biosecurity is the rising cost of health care in industrialized nations. In 2004, the thirty countries of the Organization for Economic Cooperation and Development (OECD) spent an average of 8.8 percent of their GDP on health, up from 7 percent in 1990. Indeed, in every country but Finland, the rise in health care costs over this period outstripped the rise in GDP. Governments are responsible for 73 percent of that spending on average. Even in the US, despite a predominantly private health system, the government still finances 45 percent of all health care costs largely through its Medicare and Medicaid programs (Organization for Economic Cooperation and Development 2006). The US, the extreme example of rising health costs, already spends 15.3 percent of its GDP, or $1.8 trillion, on health. This is $6,012 per capita, or more than twice the OECD average (see Figure 7).

American health spending is projected to grow to 18.7 percent of the GDP or $3.6 trillion by 2014 (Heffler et al. 2005). The high costs of healthcare in the US are reducing its competitiveness in manufacturing and elsewhere as employer-funded health care benefits are reflected in a much higher wage bill than in other industrialized countries. This results in unemployment and loss of employer-linked health insurance for American workers. In the US and elsewhere, the rising health bill means that governments will either have to raise taxes, require people to pay more of the cost of health care privately, or reduce spending on other government programs. Each of these options involves difficult trade-offs but perhaps the development of most concern would be a decline in spending on other social priorities like education, infrastructure, or international assistance, or an increase in out-of-pocket financing which will reduce the access to care for the poor or cause serious financial hardship. Researchers found that rising health care costs contribute to drops in health insurance coverage (Chernew et al. 2005).

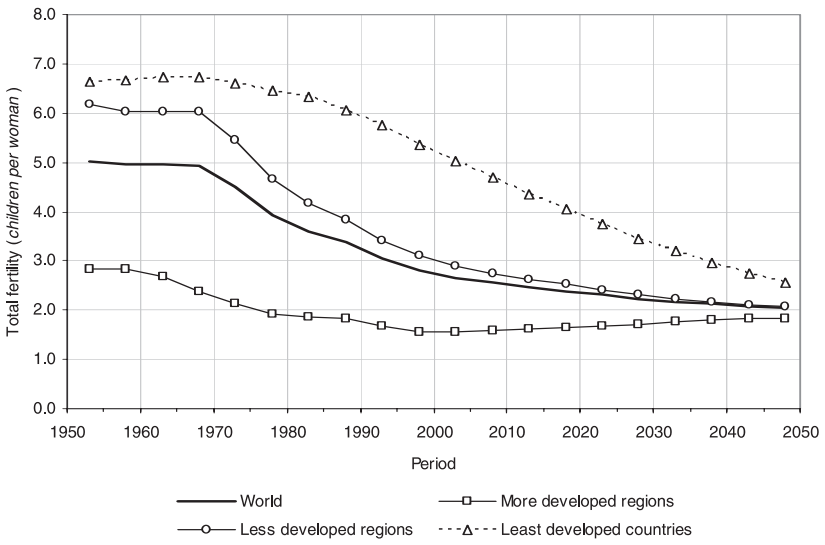
Linkages between Health and Other Areas

There are many non-health sector determinants of health and some of these may pose risks for biosecurity. The discussion below highlights just a few of the more closely linked issues.

Food security and nutrition are associated with each other and with health status. One sixth of the world's population is chronically or acutely malnourished. Most of them live in India, China, and sub-Saharan Africa. Acute hunger is a result of famines and disasters, whereas chronic hunger, which causes stunted growth and low weight in children, is by far more common (UN Millennium Project 2005a). Low weight, which undermines the ability of the immune system to fight disease, is a factor in over half of the ten million annual child deaths globally (Black et al. 2003). In his *Coping with Crisis* Working Paper on food security, Marc Cohen outlines the links between food and health and discusses approaches to improving the food supply and nutrition.[8]

Conflict and violence, be they perpetrated by nations, terrorists, or organized criminals, have a clear and incontrovertible effect on health. In the 1990s up to one quarter of the world's population was living in countries affected by conflict (UN Millennium Project 2005b). Conflict affects health directly and indirectly. For example, the recent war in the Democratic Republic of the Congo killed 3.3 million people between 1998 and 2003. Even now, after the end of hostilities, mortality is up by 75 percent over the prewar period. In a dramatic demonstration of the indirect but deadly effects of conflict, more than half the deaths in zones still experiencing violence are due to fever, malaria, diarrhea, respiratory infections, and malnutrition. In contrast, continuing sporadic violence accounts for only 30 percent of fatalities. Overall, children under the age of five are the most common fatalities, accounting for 45 percent of the dead (Coghlan et al. 2006). The preponderance of indirect deaths in post-conflict settings suggests that the devastation of health systems, agriculture, and government services play a major role in magnifying the effects of conflict on health.[9]

[8] Marc Cohen, "Food Security: Vulnerability despite Abundance," *Coping with Crisis* Working Paper Series, International Peace Academy, New York, June 2007.
[9] Andrew Mack, "Global Political Violence: Explaining the Post-Cold War Decline," *Coping with Crisis* Working Paper Series, International Peace Academy, New York, March 2007.



Source: Population Division of the Department of Economics and Social Affairs of the UN Secretariat. "World Population Prospects: The 2004 Revision." New York: UN Department of Economic and Social Affairs, 2004.

Figure 8

Population trends also exert a strong effect on health. The empowerment of women through education, family planning, better employment opportunities, more equitable property rights, and evolving cultural norms is a major driver of declining fertility rates worldwide. In developing countries, fertility rates will likely fall precipitously over the next fifty years (see Figure 8). Countries in which the dependency ratio (ratio of the economically dependant part of the population to those in the productive age group, generally defined as fifteen to sixty-four) is high are likely to experience high health costs, with the harmful effects discussed above. The Centers for Disease Control and Prevention (CDC), among others, have warned of the health and social costs of aging in developed countries (Centers for Disease Control and Prevention 2003). For many rich countries where birth rates are low this translates to the aging of the population, which will strain national health budgets as costs of care of the elderly rise while taxes and social security revenues from the shrinking workforce fall.[10] Table 4 shows that the proportion of people in the world over sixty years of age has risen from 8.2 percent in 1950 to 10.4 percent in 2005 and will double to 21.7 percent by 2050 (Population Division of the Department of Economic and Social Affairs of the UN Secretariat 2004).

International migration, a feature of globalization, has an important effect on health in the developing world through the brain-drain of health professionals from poor to rich countries. A recent analysis showed that approximately one quarter of physicians in the US, UK, Canada, and Australia were foreign-trained, with forty to 75 percent of those coming from lower-income countries (Mullan 2005). In practice this means that Ghana, a typical exporter of physicians, has 1,842 physicians left in Ghana for a population of eighteen million, with nearly half as many (791) working in the four aforementioned countries (Mullan 2005). In 2005 an expert group concluded that Africa will need (at least) another 1 million health workers (e.g., doctors, nurses, and midwives) between now and 2015 to meet the health Millennium Development Goals (Joint Learning Initiative 2004).

Potential Crises

Some of the challenges discussed above, like the rise of chronic diseases, declining fertility, and the threat of bioterrorism present risks for all countries, and as such could engender global cooperation by offering the potential for a joint response. Other challenges,

[10] Joseph Chamie, "Population Trends: Humanity in Transition," *Coping with Crisis* Working Paper Series, International Peace Academy, New York, June 2007.

World population over age 60, 1950-2050

Year	Population in Thousands	Percent
1950	205,363	8.2
1955	225,164	8.2
1960	246,353	8.1
1965	275,142	8.2
1970	311,897	8.4
1975	349,738	8.6
1980	382,354	8.6
1985	429,031	8.9
1990	486,512	9.2
1995	543,484	9.5
2000	609,242	10.0
2005	672,386	10.4
2010	764,738	11.2
2015	893,031	12.4
2020	1,031,363	13.6
2025	1,192,603	15.1
2030	1,366,650	16.7
2035	1,530,050	18.1
2040	1,665,342	19.1
2045	1,810,680	20.3
2050	1,968,153	21.7

Source: Population Division of the Department of Economic and Social Affairs of the UN Secretariat. "World Population Prospects: The 2004 Revision." New York: UN Department of Economic and Social Affairs, 2004.

Table 4

however, will affect specific regions, and thus have the potential to widen existing fissures among countries. The latter group includes the aging of societies that will strain national budgets of Europe, North America, and the rest of the developed world. Diseases of lifestyle and aging (diabetes, Alzheimer disease, ischemic heart disease) as well as mental health problems (depression, alcoholism), all of which require complex and costly, long-term treatment, will dominate the total burden of disease (Mathers and Loncar 2005). Health budgets will be further taxed by growing expenditures on defenses against terrorism and emerging diseases. In the United States alone, spending on research and development of a response to chemical, biological, radiological, or nuclear weapons grew from $53 million in Fiscal Year 2001 to $1.8 billion in Fiscal Year 2006—a thirty-four-fold increase in five years. Project BioShield, a new US effort to develop effective countermeasures to these threats, has a budget of $6.5 billion over ten years (US Department of Health and Human Services 2006).

On the other side of the economic divide is the inadequate response to infectious and other treatable diseases in developing countries, especially those of sub-Saharan Africa, which will kill millions of children and adults prematurely while devastating societies and economies. Each year nearly 11 million children die despite the fact that we could save two-thirds with widely available technologies. The vast majority of these deaths are in the developing world (Black et al. 2003). In WHO's baseline projection, HIV/AIDS and perinatal conditions, or diseases at birth, will continue to be the two largest contributors to the total disease burden in low-income countries in 2030 (Mathers and Loncar 2005). Without action, these and other stark disparities in health between rich and poor will continue to deepen the rift among countries and fuel disaffection with the global status quo. Given the underfunded and understaffed health systems of developing countries, emerging diseases also pose a much greater threat to those countries than they do in the rich world, as amply demonstrated by the AIDS pandemic. For example, the World Bank estimates that mortality rates from avian influenza in developing countries would be double those of developed countries and GDP loss would also be higher (World Bank 2006b).

Similar conclusions have been made by economists and health experts such as the High-Level Panel on Threats, Challenges, and Change, mentioned earlier. In 2005, the UN Millennium Project in its final report underlined the crucial role that international cooperation and substantially increased funding would have to play to reach the health and other

MDGs, and it sketched out a bleak picture of the world in the absence of such cooperation (UN Millennium Project 2005b).

Managing the Risks

The risks to our collective security, broadly defined, can be managed with appropriate national and international action. This action must be commensurate both with the magnitude and the urgency of the problems.

Communities

At the national level, families and communities are the first line of resistance against emerging health threats. Health education and women's empowerment are both essential ingredients in a robust response to disease, but these cannot be effective without an adequate health system to respond to health needs. These health systems involve functioning, responsive facilities staffed with health workers that are located close to the population and provide free essential services. Such health systems require adequate funding and motivated health workers as well as management systems that ensure high quality and equity. Population health services such as ensuring clean water and safe food, monitoring for disease outbreaks and epidemics, and educating the population about health threats are also important.

National Governments

Governments have traditionally played, and continue to play, a very large role in health care organization and financing in developed countries. Democratically elected national governments have both the authority and the obligation to respond to the health needs of their people and so are best positioned to organize and finance health systems—although, with appropriate regulation, health services can successfully be provided by either public or private actors. Among members of the Organization of Economic Cooperation and Development, for example, governments finance an average of 73 percent of all health expenditures (Organization for Economic Cooperation and Development 2006). So it is ironic that in developing countries bilateral and multilateral institutions have spent twenty years, in the 1980s and 1990s, trying to shift control of health systems from governments to the private sector and to communities in an attempt to introduce market-based reforms meant to improve efficiency and quality. Instead these structural adjustment programs, as the policies collectively came to be known, seriously undermined health systems. Today their legacy is apparent in the diminished authority of Ministries of Health, reduced government funding for health care, fewer civil service positions for health workers, and user fees for basic services that have been shown to reduce access to those services and contribute to impoverishment (Logie and Woodroffe 1993, Xu et al. 2003, Nabyonga et al. 2005).

Therefore the international community must first do no harm in its attempts to assist developing countries in tackling health crises. But beyond that the challenge to international actors—be they bilateral partners, multilateral organizations, NGOs, foundations, or businesses—is great. Bilateral donor agencies need to make several key changes to their operating procedures and to their funding levels to assist developing countries in building sustainable health systems. Perhaps most important is increasing their investment in development.

Today, industrialized countries spend approximately $65 billion per year on official development assistance (ODA)—direct bilateral aid from rich countries to developing country governments. The UN Millennium Project estimates that development assistance needs to rise to $135 billion by 2015 to meet the MDGs, including the health-related MDGs. There are some positive signs that industrialized countries are beginning to answer this call. As of June 2005, sixteen out of twenty-two high-income donor countries have met or agreed to meet the target of spending 0.7 percent of their GDP on development assistance by 2015 (UN Millennium Project 2005b). The challenge now is that adequate amounts of aid will need to be directed to building health systems. The need is substantial—the Global Health Council estimates that current annual global expenditures from all sources on child health, women's health, infectious diseases, and HIV/AIDS in high-burden countries are approximately $26 billion, whereas the need is $66 billion (Global Health Council 2006).

The way that development assistance is delivered is also crucial. Traditionally, development funding has been short-term (given in one-year allotments) and targeted to projects of interest to (and often controlled by) donors. The large number of projects funded by donor agencies made the reporting requirements onerous for the recipient country, diverting the attention and time of civil servants away from planning and management. The result was that governments were unable to direct aid money to longer-term national health strategies such as training

doctors and nurses or building and rehabilitating the national network of health centers—activities that require predictable and long term funding. To address these shortcomings in the aid system, the High-Level Forum on Aid Effectiveness, a meeting of developed and developing country governments in 2005, produced the Paris Declaration on Aid Effectiveness. This document commits donor countries to pool aid to support national development strategies, make aid more long-term and predictable, use existing government systems for reporting where possible, help strengthen public financial management, untie aid, and harmonize aid to prevent duplication (High-Level Forum on Aid Effectiveness 2005).

Regional Organizations

Regional organizations have traditionally not played a major role in public health, focusing instead on cross-border issues such as trade, transport, and security. However, increasingly, organizations like the European Union (EU) and the African Union (AU) have taken on health issues. The EU, already the largest contributor of official development assistance to Africa, is taking a lead on urging aid increases and the streamlining of aid from the member countries. In domestic public health, the EU created the European Centre for Disease Prevention and Control (ECDC) in 2005 to better coordinate the EU's response to emerging diseases and bioterrorism. The EU also exerts a strong regulatory role, such as in enacting bans on tobacco advertising and creating single new drug approval standards. The EU is also aiming to spur innovation by investing in research, with a plan to spend €54 billion between 2007 and 2013, in several areas including health (European Union 2006). The AU, with many fewer resources, has taken on a normative and regulatory role in Africa, for example, by convening meetings of health ministers on priority health topics. In sum, the most important role regional organizations can play in mitigating threats to biosecurity appear to be in the areas of standard setting/regulation and in coordinating or harmonizing joint response to health threats.

Global Multilateral Organizations

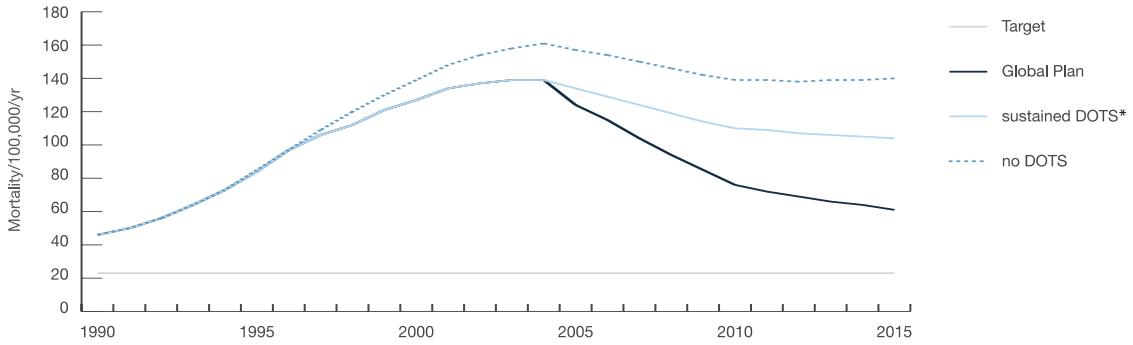
Global multilateral organizations like the United Nations, the World Bank, the International Monetary Fund (IMF), and regional development banks also need to align their support for a joint global response to common threats and rally behind an agenda for strengthening health systems in developing countries.

The WHO is very well positioned to coordinate a global response to emerging diseases and bioterrorism. This was illustrated during the SARS crisis and more recently with avian influenza. In both cases, the WHO assisted local authorities in diagnosing and monitoring outbreaks, connected local health workers with international experts, and issued regular reports and travel advisories to the global community. The WHO also assisted countries in identifying response scenarios and stockpiling medicines and vaccines. A promising mechanism for this work is the WHO's Global Outbreak Alert and Response Network (GOARN), established in 2000, which seeks to pool human and technical resources from different countries to assist in identifying and responding to outbreaks of international importance. It also monitors the World Wide Web for reports of potentially concerning diseases to identify possible outbreaks at their earliest stage. GOARN works with UN organizations like the United Nations Children's Fund (UNICEF), but also with international NGOs like the International Committee of the Red Cross (ICRC) and *Médecins sans Frontières* (MSF), academic institutions and laboratories (WHO 2006). Networks like GOARN are an excellent illustration of the potential of the UN to coordinate international response to health threats in a way that optimizes our collective capacity.

Other collaborations led by the UN have also been effective. The "Stop-TB" Department of the WHO, which works closely with an international partnership, also called Stop-TB, has brought much needed energy to the global fight against TB with clear, focused, and actionable analysis and reporting. Importantly, Stop-TB also supports countries by maintaining a stockpile of TB drugs purchased at the lowest available prices and by calculating the resources required to fight the disease in order to assist countries with raising funds. While the goals for TB detection are still far from being reached (currently standing at 45 percent of predicted cases versus a target of 70 percent), the cure rates globally are 82 percent, close to the 85 percent target (Stop-TB Partnership 2006). Stop-TB effectively uses analytic tools to galvanize support and educate the public (see for example the scenarios in Figure 9).

In part as a result of this coherent approach, the private sector and foundations are responding with greater investments. At the launch of the "Global Plan to Stop-TB," Bill Gates announced that his foundation would triple its funding for TB to $900 million over the next decade. More recently, the G8 countries at the St. Petersburg summit pledged to support the

TB mortality scenarios in high HIV-prevalence African countries



*Directly Observed Treatment, Short-Course (DOTS)

Source: Stop-TB Partnership. "The Global Plan to Stop TB: 2006-2015." Geneva: Stop-TB Partnership, 2006.

Figure 9

global fight against TB and to strengthen GOARN (Group of 8 2006).

The UN, because of its perceived neutrality and its strong reputation in peacekeeping, is also well positioned to play an important role in assisting post-conflict states to rebuild their health systems. Health systems in post-conflict and other fragile states are not only a response to urgent health problems but, if functioning and responsive, may also increase public support for the government (Jones et al. 2006). The new UN Peacebuilding Commission, working with the WHO, could take the lead on organizing and directing donor response to conflict strategically to strengthen health systems rather than creating multiple, vertical health projects that cannot be sustained.

The UN's effectiveness in all of its activities is compromised when its inherent consultative structure and consensus-requiring deliberative processes prevent it from making a firm stand on important health issues. This is compounded by the sheer size of the UN's agenda, encompassing crisis response and a multitude of long-term development issues, that strains its capacity to prioritize and respond. This can result in lowest-common denominator resolutions that lack clarity and authority. Some of this is due to the micromanagement of the actions of UN agencies, funds, and programs by member states, further compounded by arrears in budget disbursement by the members. UN agencies are also prone to internal conflicts and schisms among the different agencies that prevent them from fully harnessing their global coordination, planning, and communication functions. This is in part because the accountability structures for the different agencies, funds, and programs do not encourage internal coherence much less support for a common approach. UN specialized agencies including WHO, ILO, FAO, the World Bank Group, IMF, and UNESCO report to their own assemblies of member nations, whereas funds and programs like UNDP, UNIFEM, and UNHCR, report to the General Assembly of the United Nations. The latter arrangement encourages a common approach to problems, whereas the former can result in pressure to move in different directions. These disagreements weaken the normative role of the UN in the global community.

A major weakness in the performance of UN agencies in assisting developing countries in scaling up their health systems is their limited impact on the ground. While the WHO, for example, is effective in setting international standards and guidelines, its technical assistance to countries is inadequate in terms of expertise and financing. Health economists, critical to planning the expansion of health systems, for example, are often in short supply in country and even in regional offices. To address this, the immediate past Director-General, Dr. J.W. Lee, pledged to reduce the budget of the WHO going to headquarters from 36 percent to 20 percent by 2008 (WHO 2003a). There is a similar concern with other UN entities like UNICEF and UNAIDS. A related issue is the lack of coordination among agencies resulting in different agency priorities in health and no common health

agenda. The UN has tried to address this by appointing a UN Resident Coordinator to help harmonize the work of all UN agencies in a country and by instituting a shared assessment tool, the Common Country Assessment, and a shared work plan, the UN Development Assistance Framework (UNDAF) for use by all UN agencies. While these are commendable measures, their success is limited by the lines of accountability that compel country representatives of different UN agencies to respond to the priorities of their respective global headquarters rather than those of the local UN country team.

Private Organizations

While governments and multilateral institutions have the major responsibility for managing global threats to biosecurity, private philanthropic organizations are taking on a more visible role. Large philanthropic organizations, such as the Bill and Melinda Gates Foundation, are shaping the global public health response to health crises through sheer spending power and often novel ways of looking at the issues and solutions. The Gates Foundation, which focuses on global health, has an endowment of $29 billion and gave away $1.36 billion in 2005. By comparison, in 2004 total international aid for health to developing countries, from all sources, was $12.7 billion. Warren Buffet's recent gift of approximately $37 billion worth of Berkshire Hathaway stock to the Gates Foundation will raise the Foundation's annual giving closer to $3 billion per year—raising its profile and power in global public health substantially (Okie 2006). The Gates' and Buffet's involvement in global health could spur other wealthy individuals to invest similarly. While the financial power of philanthropic organizations cannot on its own close the funding gap—to meet the health MDGs current aid levels would have to rise three-to-seven-fold (Gottret and Schieber 2006)—philanthropists will clearly be increasingly important players in global priority-setting and in investments.

Another important actor is the for-profit private sector. As noted earlier, the private pharmaceutical industry is the largest provider of drugs and therapeutics to fight established and new diseases. Ensuring that innovation keeps pace with the need requires rethinking the existing approach to research and development to include new scientific methods like computer-based predictive models, biomarkers for safety and effectiveness and new clinical evaluation techniques, among others (Food and Drug Administration 2004). The pharmaceutical industry must also do its share to redress the gap between the focus of research and development and global health needs. This would likely require a transformation in market-based pharmaceutical production that may include the re-examination of the length of patent protection, the formation of buying cooperatives with purchase commitments to create viable markets, and exemptions from international agreements on exporting needed drugs to and between developing countries (including TRIPS, or trade-related aspects of international property rights).

Private companies also contribute to global public health by providing prevention education and health care in the workplace and to communities, and by mitigating occupational health hazards. For example the Global Business Coalition on HIV/AIDS, a network of 200 companies worldwide, advocates for comprehensive workplace HIV prevention and treatment programs and publishes best practice case studies to share innovations (Global Business Coalition on HIV/AIDS 2006). The strengths of business in innovation, strategic thinking, and operationalizing programs can be valuable assets in dealing with global health challenges. However, business should not be expected to take on a major role in providing health services or solving other public health challenges. Its profit-orientation will naturally limit the extent of investment on activities with limited or no return to the bottom line and access to the conditions for maximizing health is a human right and thus protecting health should remain the core responsibility of governments.

Scenarios and Recommendations

Several future scenarios are possible, largely determined by our ability, or inability, to mobilize the organizational, human, and financial resources to implement what we already know.

Worst Case Scenario: Catastrophe

The worst case scenario is one in which the current momentum on global cooperation in health falters. Rich countries would not be able to resolve their differences in approaching the threats of emerging diseases and bioterrorism or would turn inward, focusing only on responding to threats within their borders. That would not only create huge inefficiencies by duplicating research and technologies for combating the new threats but also dangerous schisms between countries further along the route to, for

example, a new avian flu vaccine, and the rest. The continuing crisis in innovation would exacerbate the situation. In this new unilateral world, UN institutions like the WHO would be reduced to issuing guidelines on disease response that the more powerful disregard and others cannot meet on their own.

In this scenario, the avian flu virus jumps to humans in an easily transmissible form in one country in Asia, which suppresses the information from other countries. Within days, travelers carry the new pathogen throughout the world. Rich countries with surveillance systems are the first to identify the cause of the flu cases they see in global hubs such as New York, London, Paris, or Tokyo. They close their borders to travel and trade, virtually shutting down the global economy. Despite the WHO's urging, national stockpiles of Tamiflu, the main drug to fight the flu, are only sufficient to cover health and government workers, and riots ensue to gain access to the drug in Europe and North America. Meanwhile in Africa, the disease begins more slowly in the commercial centers but with a minimal response from weak public health systems quickly spreads through the highly susceptible populations, already weakened by AIDS, malaria, and malnutrition. It is especially devastating to southern African countries where HIV prevalence is high.

Middle Scenario

In this scenario the same avian flu outbreak would elicit a different response. The US, Western Europe, Australia, and Japan have stockpiled enough Tamiflu to immediately begin mass treatment in their large cities, reducing transmission, deaths, and panic. They also activate vaccine production facilities within their own borders and create a targeted vaccine, and begin immunizing high-risk and high-priority populations. These countries close their borders to travel but continue to trade with non-endemic countries, shutting out Asia. However, within weeks, the WHO and the EU ship stockpiled drugs and new vaccines to Asia, Africa, and the Middle East, which stabilizes the crisis there. The overall disruption to the world economy is significant but manageable.

The flu, however, diverts the world's attention from other urgent health problems, like HIV/AIDS. AIDS treatment in Africa halts as trade is curtailed and aid budgets shrink. As a result, large numbers of those previously kept healthy and productive by antiretroviral drugs would die, causing further disruption for African economies and anger toward national governments and donors. It takes several years to revert to normal public health functioning in the rich world, and much longer in developing countries.

Best Case Scenario

In this scenario, rich and poor countries immediately begin investing in more effective joint response to crises as well as shoring up weak health systems. When avian flu hits in Asia, improved surveillance systems detect it within hours and the WHO alerts all countries and begins distributing drugs and vaccines to those at highest risk. The EU and US vaccinate essential personnel but also contribute to containing the epidemic in Asia, which slows transmission. The global toll is high but vastly smaller than in the other scenarios, and importantly, the joint response averts mass resentment and retaliation. Close cooperation in surveillance and treatment reduces the resources required to fight emerging diseases and leaves more available to deal with chronic disease at home and priority health problems in developing countries.

With the flu epidemic contained, the world reaches the Millennium Development Goals in 2015 for most countries and can now reap both the human and the economic benefits. An additional 30 million children and 2 million mothers survive (UN Millennium Project 2005b), for example, as well as many millions more who would have died from infectious diseases like TB and AIDS. And these are just the direct health gains. The gains to communities and economies are vast. Controlling malaria raises labor productivity and expands the economies of African countries. Foreign investors, seeing healthier and better educated African workers, now consider the continent to be undervalued and move in to explore manufacturing and information industries. With the reduction in trade barriers, the new products find large markets, further increasing prosperity for people on the continent. Rising incomes in Africa, Latin America, and Asia mean more attractive markets for developed countries as well. From the perspective of stability, the prospect of a healthy life and new economic opportunities for the populations of developing countries could reduce the risk of conflict and terrorism. Thus improved health is a key input into the virtuous cycle of economic growth and rising human capital.

The top priorities for enhancing the capacity of multilateral institutions to support the achievement of the best case scenario are greater coherence, the reorientation of resources, and the managing for results. Coherence would require the realigning of accountability at the UN agencies to ensure that the UN speaks with a common voice, both globally and

in countries. The resources of multilateral institutions should be redirected to actively support the development and implementation of ambitious plans of developing countries on the ground. This would mean that the UN system should champion the needs of its poorer members more actively in the international community and continue to exert pressure to change the status quo in development assistance (e.g., increased funding, a shift from loans to grants). The UN has been most effective in the eyes of the global public when it has taken decisive action on behalf of the disadvantaged, such as when deploying peacekeepers and managing famines. The UN family needs to evaluate its progress at least in part by how much progress it can foster in the poorest countries, using clear output and outcome metrics.

The current trajectory—marked by grand ambitions but small steps— is likely to produce the middle scenario. We need not more of the same but breakthroughs, not incrementalism but action on a massive scale, not isolationism but a new multilateralism, if we hope to change course.

References

Arifeen, Shams El, Lauren S. Blum, D.M. Emadul Hoque, Enayet K. Chowdhury, Rasheda Khan, Robert Black, Cesar G. Victora, and Jennifer Bryce. "Integrated Management of Childhood Illness (IMCI) in Bangladesh: Early Findings from a Cluster-Randomised Study." *The Lancet* 364 (2004): 1595-602.

Black, Robert, Saul Morris, and Jennifer Bryce. "Where and Why Are 10 Million Children Dying Every Year?" *The Lancet* 361 (2003): 2226-34.

Braveman, Paula, and Sofia Gruskin. "Defining Equity in Health." *Journal of Epidemiology and Community Health* 57, no. 4 (2003): 254-58.

Centers for Disease Control and Prevention. "Public Health and Aging: Trends in Aging: United States and Worldwide." *Morbidity and Mortality Weekly Report (MMWR)* 52, no. 6 (2003): 101-06.

———. "Infant Mortality and Low Birth Weight among Black and White Infants: United States, 1980-2000." *MMWR* 51, no. 27 (2002): 589-92.

Chambers, Henry F. "The Changing Epidemiology of Staphylococcus Aureus?" *Emerging Infectious Diseases* 7, no. 2 (2001): 178-82.

Chernew, Michael, David M. Cutler, and Patricia Seliger Keenan. "Increasing Health Insurance Costs and the Decline in Insurance Coverage." *Health Services Research* 40, no. 4 (2005): 1021-39.

Coghlan, Benjamin, Richard J. Brennan, Pascal Ngoy, David Dofara, Brad Otto, Mark Clements, and Tony Stewart. "Mortality in the Democratic Republic of Congo: A Nationwide Survey." *The Lancet* 367, no. 9504 (2006): 44-51.

European Union. "Overviews of the European Union Activities." 2006. Available at http://europa.eu/pol/rd/overview_en.htm.

Food and Drug Administration. "Innovation or Stagnation—Challenge and Opportunity on the Critical Path to New Medical Products." Bethesda, Maryland: Food and Drug Administration, 2004.

Global Business Coalition on HIV/AIDS. "What We Do." 2006. Available at http://www.businessfightsaids.org.

Global Forum for Health Research. "Poverty, Equity, and Health Research." Geneva: Global Forum for Health Research, 2005. Available at http://www.globalforumhealth.org/Site/002__What%20we%20do/005__Publications/009__Forum%20Reports.php.

———. "Monitoring Financial Flows for Health Research." Geneva: Global Forum for Health Research, 2004.

Global Health Council. "Global Health Opportunities." Washington, DC: Global Health Council, 2006.

Gottret, Pablo, and George Schieber. "Health Financing Revisited: A Practitioner's Guide." Washington, DC: World Bank, 2006.

Group of Eight. "Fight against Infectious Diseases: A Communique from the St. Petersburg Summit of the G8." July 2006. Available at http://en.g8russia.ru/docs/10.html.

Hart, Julian Tudor. "The Inverse Care Law." *The Lancet* 1 (1971): 405-12.

Heffler, Stephen, Sheila Smith, Sean Keehan, Christine Borger, M. Kent Clemens, and Christopher Truffer. "Trends: US Health Spending Projections for 2004-2014." *Health Affairs* (2005): hlthaff.w5.74.

High-Level Forum on Aid Effectiveness. "Paris Declaration on Aid Effectiveness." Paris: High-Level Forum on Aid Effectiveness, 2005.

High-Level Panel on Threats, Challenges and Change. "A More Secure World: Our Shared Responsibility." New York: United Nations, 2004.

Institute of Medicine. "Preventing Medication Errors: Quality Chasm Series." Washington, DC: Institute of Medicine, 2006.

International Labour Office. "HIV/AIDS and Work: Global Estimates, Impact and Responses." Geneva: International Labour Office, 2004.

Joint Learning Initiative. "Human Resources for Health: Overcoming the Crisis." Cambridge, MA: Harvard University Press, 2004.

Jones, Gareth, Richard Steketee, Robert Black, Zulfigar A. Bhutta, Saul Morris, and The Bellagio Child Survival Study Group. "How Many Child Deaths Can We Prevent This Year?" *The Lancet* 362 (2003): 65-71.

Jones, Seth G., Lee H. Hilborne, C. Ross Anthony, Lois M. Davis, Federico Girosi, Cheryl Benard, Rachel M. Swanger, Anita Datar Garten, and Anga Timilsina. *Securing Health: Lessons from Nation-Building Missions*. Santa Monica, CA: RAND, 2006.

Kessler, Ronald C., Amanda Sonnega, Evelyn Bromet, Michael Hughes, and Christopher B. Nelson. "Posttraumatic Stress Disorder in the National Comorbidity Survey." *Archives of General Psychiatry* 52, no. 12 (1995): 1048-60.

Khardori, Nancy "Bioterrorism and Bioterrorism Preparedness: Historical Perspective and Overview." *Infectious Disease Clinics of North America* 20, no. 2 (2006): 179-211, vii.

Kortepeter, Mark G., and Gerald W. Parker. "Potential Biological Weapons Threat." *Emerging Infectious Diseases* 5, no. 4 (1999): 523-7.

Logie, Dorothy E., and Jessica Woodroffe. "Structural Adjustment: The Wrong Prescription for Africa?" *British Medical Journal* 307, no. 6895 (1993): 41-44.

Mathers, Colin D., and Dejan Loncar. "Updated Projections of Global Mortality and Burden of Disease, 2002-2030: Data Sources, Methods and Results." Geneva: WHO, 2005.

McMichael, Anthony J. "Mortality Trends and Setbacks: Global Convergence or Divergence?" *The Lancet* 363, no. 9415 (2004): 1155-9.

Mullan, Fitzhugh. "The Metrics of the Physician Brain Drain." *New England Journal of Medicine* 353, no. 17 (2005): 1810-8.

Nabyonga, Juliet, Martinus Desmet, Humphrey Karamagi, Patrick Y. Kadama, Francis G. Omaswa, and Oladapo Walker. "Abolition of Cost-Sharing Is Pro-Poor: Evidence from Uganda." *Health Policy and Planning* 20, no. 2 (2005): 100-08.

Okie, Susan. "Global Health: The Gates-Buffet Effect." *New England Journal of Medicine* 355, no. 11 (2006): 1084-8.

Organization for Economic Cooperation and Development. "Rising Health Costs Put Pressure on Public Finances, Finds OECD." 2006. Available at http://www.oecd.org/document/37/0,2340,en_2649_37407_36986213_1_1_1_37407,00.html.

Population Division of the Department of Economic and Social Affairs of the UN Secretariat. "World Population Prospects: The 2004 Revision." New York: UN Department of Economic and Social Affairs, 2004.

Ronsman, Carine and Wendy Graham. "Maternal Mortality: Who, When, Where, and Why." *The Lancet* 363 (2006): 1189-1200.

Sachs, Jeffrey, and Pia Malaney. "The Economic and Social Burden of Malaria." *Nature* 415, no. 6872 (2002): 680-5.

Stop-TB Partnership. "The Global Plan to Stop TB: 2006-2015." Geneva: Stop-TB Partnership,2006.

Tanzania IMCI Multi-country Evaluation Health Facility Survey Study Group. "The Effect of Integrated Management of Childhood Illness on Observed Quality of Care of Under-Fives in Rural Tanzania." *Health Policy and Planning* 19, no. 1 (2004): 1-10.

UN Millennium Project. "Halving Hunger: It Can Be Done." Task Force on Hunger. New York: UN Millennium Project, 2005a.

———. "Investing in Development: A Practical Plan to Achieve the Millennium Development Goals." New York: UNDP, 2005b.

———. "UN Millennium Project Website." Available at http://unmillenniumproject.org/involved/action07.htm.

———. "Who's Got the Power? Transforming Health Systems for Women and Children." Task Force on Child Health and Maternal Health. New York: UN Millennium Project, 2005c.

UNAIDS. "2006 Report on the Global Aids Epidemic." Geneva: UNAIDS, 2006.

Urdal, Henrik. "The Devil in the Demographics: The Effect of Youth Bulges on Domestic Armed Conflict,1950-2000." Washington, DC: World Bank, 2004.

US Department of Health and Human Services. "Draft HHS Public Health Emergency Medical Countermeasures Enterprise (PHEMCE) Strategy for Chemical, Biological, Radiological and Nuclear (CBRN) Threats." *Federal Register* 71, no. 174 (2006): 53097-102.

Victora, Cesar G., Adam Wagstaff, Joanna A. Schellenberg, Davidson R. Gwatkin, Mariam Claeson, and Jean-Pierre Habicht. "Applying an Equity Lens to Child Health and Mortality: More of the Same Is Not Enough." *The Lancet* 362 (2003): 233-41.

Word Health Organization. "Global Outbreak Alert and Response Network Website." 2006. Available at http://www.who.int/csr/outbreaknetwork/en/.

———. "Public Health Response to Chemical and Biological Weapons: WHO Guidance." Geneva: World Health Organization, 2004.

_____. "Avian Influenza: Frequently Asked Questions." 5 December 2005a. Available at http://www.who.int/csr/disease/avian_influenza/avian_faqs/en/index.html#areall.

———. "Avian Influenza: Assessing the Pandemic Threat." Geneva: World Health Organization, 2005b.

———. "Diabetes Mellitus Fact Sheet." http://who.int/topics/diabetes_mellitus/en/.

———. "Hemorrhagic Fevers." http://www.who.int/topics/haemorrhagic_fevers_viral/en/.

———. "Dr. Lee Jong-wook's Presentation to the Executive Board, 27 January 2003." 2003a. http://www.who.int/dg/lee/speeches/2003/27_01/en/index.html.

———. "Tuberculosis Fact Sheet." http://www.who.int/mediacentre/factsheets/fs104/en/#drugresistant.

———. "World Health Report 2003—Shaping the Future." Geneva, 2003b.

———. "WHO Multi-Country Study on Women's Health and Domestic Violence: Progress Report." Geneva: World Health Organization, 2001.

Word Health Organization and World Bank. "World Report on Road Traffic Injury Prevention." Geneva: World Health Organization, 2004.

World Bank. "Avian Flu and Pandemic Flu." Available at http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20649058~menuPK:34480~pagePK:64257043~piPK:437376~theSitePK:4607,00.html. 2006a.

———. "Economic Impact of Avian Flu." Available at http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/EXTEAPREGTOPHEANUT/0,,print:Y~isCURL:Y~contentMDK:20713527~pagePK:34004173~piPK:34003707~theSitePK:503048,00.html. 2006b.

———. "World Development Indicators Online." Available at http://devdata.worldbank.org/dataonline/. 2006c.

Xu, Ke, David B. Evans, Kei Kawabata, Riadh Zeramdini, Jan Klavus, Christopher J.L. Murray. "Household Catastrophic Health Expenditure: A Multicountry Analysis." *The Lancet* 362, no. 9378 (2003): 111-17

Further Reading

Global Forum for Health Research. "Monitoring Financial Flows for Health Research." Geneva: Global Forum for Health Research, 2004.

This report is part of an ongoing series on research priorities for the global pharmaceutical industry and the global clinical need for new therapies.

Joint Learning Initiative. "Human Resources for Health: Overcoming the Crisis." Cambridge, MA: Harvard University Press, 2004.

This landmark report discusses the importance of health workers in scaling up health systems around the globe in the context of globalization.

Juckett, Gregory. "Avian Influenza: Preparing for a Pandemic." *American Family Physician* 74, no. 5 (2006): 783-90.

This article reviews the recent outbreaks in Asia and outlines the steps for a containment strategy.

Khardori, Nancy. "Bioterrorism and Bioterrorism Preparedness: Historical Perspective and Overview." *Infectious Disease Clinics of North America* 20, no. 2 (2006): 179-211, vii.

This is a recent thorough review of the state of the art in bioterrorism preparedness and likely agents of bioterror.

Lopez, Alan D., Colin D. Mathers, Majid Ezzati, Dean T. Jamison, and Christopher J. Murray. "Global and Regional Burden of Disease and Risk Factors, 2001: Systematic Analysis of Population Health Data." *The Lancet* 367, no. 9524 (2006): 1747-57.

This article summarizes current mortality and disease burden patterns as well as recent historic trends around the globe.

Sachs, Jeffrey and Pia Malaney. "The Economic and Social Burden of Malaria." *Nature* 415, no. 6872 (2002): 680-5.

This paper assesses the burden of malaria in Africa. It is frequently cited and has been used as a model for developing other projections for financial burden of disease.

World Health Organization. "Macroeconomics and Health: Investing in Health for Economic Development: Report of the Commission on Macroeconomics and Health." Geneva: World Health Organization, 2001.

This report explores the links between health and development and quantifies both the costs of providing essential services in less-developed countries and the associated benefits.

The **International Peace Academy** is an independent, international institution dedicated to promoting the prevention and settlement of armed conflicts between and within states through policy research and development.

Coping with Crisis is a multi-year research and policy-facilitation program on emerging human and international security challenges and institutional response capacities.

The Coping with Crisis Working Paper Series

The Middle East: Fragility and Crisis
Markus Bouillon

Africa: Confronting Complex Threats
Kwesi Aning

Asia: Towards Security Cooperation
Michael Vatikiotis

Central Asia and the Caucasus: A Vulnerable Crescent
Thomas de Waal and Anna Matveeva

Europe: Crises of Identity
Shada Islam

Latin America and the Caribbean: Domestic and Transnational Insecurity
Arlene Tickner

Global Political Violence: Explaining the Post-Cold War Decline
Andrew Mack

New Challenges for Peacekeeping: Protection, Peacebuilding and the "War on Terror"
Richard Gowan and Ian Johnstone

Small Arms and Light Weapons: Towards Global Public Policy
Keith Krause

Ending Wars and Building Peace
Charles Call and Elizabeth Cousens

Peacemaking and Mediation: Dynamics of a Changing Field
Chester Crocker

Nuclear Weapons: The Challenges Ahead
Christine Wing

Transnational Organized Crime: Multilateral Responses to a Rising Threat
James Cockayne

Global Terrorism: Multilateral Responses to an Extraordinary Threat
Eric Rosand

Global Public Health and Biosecurity: Managing Twenty-First Century Risks
Margaret Kruk

Population Trends: Humanity in Transition
Joseph Chamie

Energy Security: Investment or Insecurity
Fatih Birol

Food Security: Vulnerability Despite Abundance
Marc Cohen

Climate Change and Conflict: The Migration Link
Nils Petter Gleditsch, Ragnhild Nordås, and Idean Salehyan

Poverty and Conflict: The Inequality Link
Ravi Kanbur

For more information about the series and electronic access to additional papers go to www.ipacademy.org/our-work/coping-with-crisis/working-papers.

International Peace Academy

777 United Nations Plaza New York, NY 10017-3521 p 212 687-4300 f 212 983-8246 www.ipacademy.org