



# ASEF–ASAP Scenarios: Accurate Scenarios, Active Preparedness

ASEF Public Health Network

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With the support of



Government of Japan

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# Executive summary

With the influenza A/H1N1 known as Swine Flu in 2009, our traditional perception of pandemics – rapidly and globally spreading diseases – was shattered to pieces. Asia and Europe learned that a pandemic does not necessarily have to be highly lethal, but can be mild. Billions can be spent in vain on preparations for a pandemic which turns out harmless.

After this experience, we need to avoid making the same mistake again. A/H1N1 may have been mild but we cannot be complacent and assume that all pandemics are and will be mild or even that any future following pandemic will be caused by an influenza virus. In fact, the current State of the Environment Report of the European Environment Agency lists as a key megatrend the risk for new and re-emerging pandemic threats.<sup>1</sup>

A/H1N1 was a wake-up call: Asia and Europe need to be better prepared for pandemics to come. But what are these pandemics of the future? And in what contexts will we be ready to fight them? What exactly should we be prepared for?

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<sup>1</sup> EUROPEAN ENVIRONMENT AGENCY, The European Environment, State and Outlook 2010, Assessment of Global Megatrends, Luxembourg, Publications Office of the European Union, 2010.

These are questions that the ASEF-ASAP (Accurate Scenarios, Active Preparedness) project aims to answer. With the support from the Government of Japan, the Asia-Europe Foundation (ASEF) initiated a multi-sectoral pandemic preparedness and response foresight project using the scenario approach. Supported by ASEF Public Health Network, the ASEF-ASAP project fills a void of foresight studies on pandemics, especially by capturing a range of pandemics that may occur within different future contexts. Using these scenarios can have a tremendous impact on improving Asia and Europe's preparedness for possible future pandemics.

The method of future scenarios has been successfully applied in many areas and by many international organisations and corporations. This is the first time it has been applied between two world regions on the issue of pandemics.

Throughout 2010, ASEF convened a panel of high-level stakeholders from across Asia and Europe. Over the course of three workshops, they were to develop a set of divergent future scenarios for pandemic preparedness in Asia and Europe that captured the realm of possible future developments. A large diversity in the panel was achieved by including personalities from many different sectors affected by pandemics: governments, the private sector, civil society organisations and media from across Asia and Europe. Through a participatory process, the panel identified and analysed driving forces, trends, uncertainties and discontinuities for pandemic

preparation. Resource persons supported the different steps of the process with their expertise. The process was facilitated by Prospex, the consulting firm specialising in foresight and stakeholder engagement.

The result of the process is a set of three scenarios for the future of pandemic preparedness: 'Grey Paradise', 'MosaInc.' and 'GloCal Blocs'. Each scenario lays out what may happen if certain developments take place, leading us to a possible future context for pandemics.

In **Grey Paradise**, Asia and Europe are dominated by global political structures with redistributed resources and authorities dominating the economy. Continuing crises lead governments to put their faith in international regimes. This step-by-step technocratic answer to financial, ecological and security challenges enables significant progress. Asian countries, fuelled by continued economic expansion, gain more power and increasingly dominate the international scene. Authoritarian governance becomes a global role model. Such global governance allows for progress in many areas. However, it also evokes increasing dissatisfaction among large sectors of the population, leading to protests and apathy. This results in blind spots for new pandemics, problems with multi-drug resistance, and new forms of widespread psychological illnesses and phenomena.

**MosaInc.** describes a future in which Asia and Europe's political structures weaken, resources become commodities and economic self-

interest rises. In a series of economic, natural and human disasters and crises, political structures fail again and again to provide effective responses. Budgetary room for manoeuvre continues to shrink. People turn to self-organisation. Civil society organisations and businesses start to provide public services that are no longer provided by state institutions. The dispersion of power leads to a mosaic of actors and structures, in which firms and corporations become the strongest players. Open and globalised markets and segregation in society are features of this innovation-rich future that is challenged by health inequalities and security problems. Classic infectious agents re-emerge, finding opportunity in the less affluent parts of societies. In contrast, in this scenario, cybernetic viruses may become the future pandemic of the affluent.

**GloCal Blocs** shows Asia and Europe developing in a world of political blocs of states which use resources for their own development and follow their own regional economic interests. Between these blocs a mix of cooperation and competition develops. Blocs do cooperate in some areas but at the same time, compete over natural resources. Conflicts are imminent. Food becomes a central element in the new power struggle. The blocs might respond very differently to pandemic threats and have very different means to fight them. Limited cooperation may lead to lockdowns and the spread of diseases between the blocs, due to miscommunication and increased genetic modification.

Each of these three scenarios comes with a first analysis of possible pandemics, the vulnerabilities of Asia and Europe, and the effects of



further large scale events, such as nuclear disasters. The three ASEF-ASAP scenarios are *not* predictions. Neither are they visions of what is desirable nor undesirable. What each scenario does is describing a relevant future development. *Together* they aim to capture the realm of everything that may be possibly relevant for pandemic preparedness. We need to be prepared for all three scenarios in order to be prepared for the future.

The next step for the ASEF-ASAP project is to use the three scenarios and their analyses to develop robust strategies for multi-sector pandemic preparedness. How can the huge variety of relevant actors in Asia and Europe collaborate to make societies well-prepared for future pandemics?

# Acknowledgments

This ASEF-ASAP participatory foresight project was organised by the ASEF Public Health Network. The process was designed and facilitated by Prospex, a specialised consulting firm for foresight and stakeholder engagement. Prospex was also responsible for reporting and conducted background research for this project. A group of high level resource persons helped to further refine the scenarios and analysis.

The project is based on the active contribution of many participants from multiple sectors that have a stake in pandemic preparedness across Asia and Europe. As a result, the ASEF-ASAP scenarios are rooted in stakeholder needs and perceptions. This guarantees the necessary relevance of the scenarios for a broad range of actors involved in effective future pandemic preparedness.

The contributions and enthusiasm of participants in the ASEF-ASAP panel were the backbone of the project. ASEF is impressed with the energy, dedication and commitment that all contributors have shown in this process, and expresses its gratitude for their work.

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# List of abbreviations and acronyms

AIDS	Acquired immune deficiency syndrome
ASEAN	Association of Southeast Asian Nations
ATWGPPR	ASEAN Technical Working Group on Pandemic Preparedness and Response
BSE	Bovine spongiform encephalopathy
ECDC	European Centre for Disease Prevention and Control
ECRE	European Council on Refugees and Exiles
EID	Emerging Infectious Diseases
EISN	European Influenza Surveillance Network
ESA	European Space Agency
GLEWS	Global Early-Warning System for Major Animal Diseases including Zoonoses
GM	Genetically modified
GMO	Genetically modified organisms
GOARN	Global Outbreak Alert and Response Network
HIV	Human immunodeficiency virus
IHR	International Health Regulations
MSA	Mutualite Sociale Agricole
NASA	National Aeronautics and Space Administration
NGO	Non-governmental organisation
R&D	Research and development
SAARC	South Asian Association for Regional Cooperation
SAGE	Strategic Advisory Group of Experts
SAME	South Asian Migrants in Europe
SARS	Severe acute respiratory syndrome
STD	Sexually transmitted disease
UN	United Nations
UNFPA	United Nations Population Fund
WHO	World Health Organization

# 1 Pandemic threats and preparedness

## *1.1. The need for a different approach*

Are we prepared for the pandemics to come? As we enter the second decade of the 21<sup>st</sup> century, unfortunately the answer still seems to be negative.

Three pandemic outbreaks in the last ten years have resulted in a rapid expansion of the pandemic preparedness architecture. Both Asia and Europe have come a long way, mostly targeting influenza viruses. Despite differences in nature and scope, most countries have now established at least minimal pandemic preparedness and response plans supported by better international cooperation.

However, the 2009 A/H1N1 influenza pandemic clearly showed that there is much scope for improvement. Preparedness and response systems proved unable to capture and deal with the mild nature of the virus. The response to the outbreak spurred allegations of creating hysteria as resources were wasted on what turned out to be a virus with a lower mortality rate than even a seasonal flu. Existing World Health Organization (WHO) rules, procedures and pandemic definitions of 2009 were insufficiently flexible.

There is a risk that the A/H1N1 experience will lead to complacency - a feeling that pandemics are overrated and that preparedness systems are more than able to deal with them. But this is far from the truth. Experts agree that it is only a matter of time for another pandemic to hit and this time the consequences may be much more serious.

It seems that we have simply been lucky with A/H1N1. The next pandemic may be far more severe.

First, a next pandemic may not come in the form of an influenza virus - yet most of our preparedness and response systems focus on influenza.

Second, preparedness systems still largely fail to reach beyond authorities, yet the involvement of other sectors and society will be vital to a swift and successful response.

**Finally, and perhaps most strikingly, our current preparedness and response systems only consider one future context, and the same holds true for the foresight studies on pandemics that have been conducted to date. Possible changes to the structure of our societies in the future have hardly been addressed. What if governments lose the authority they need to coordinate a response to an epidemic?**

In short, Asia and Europe have not found ways to accurately reflect the kind of pandemics that may come or the context in which we need to ensure preparedness and response.

In order to better prepare for future pandemics, we need to adopt a more sophisticated approach to pandemic preparedness: an approach that captures the differences in scope and nature of pandemics and the diversity of possible agents, that includes the possible future contexts of preparedness for pandemics, and that enables a more flexible, efficient and effective use of resources in response to threats of varying severity.

The remainder of this chapter further illustrates the points made above, while Chapter 2 describes how the Asia-Europe Foundation 'Accurate scenarios, active preparedness' (ASEF-ASAP) project supports the development of a new approach.

## ***1.2 The 2009-2010 A/H1N1 outbreak: a mild flu, a heated debate***

In late April 2009, the WHO announced the emergence of a novel influenza virus: A/H1N1. After early outbreaks in North America and Mexico, the new influenza virus, spread rapidly around the world. The A/H1N1 strain had been circulating among pigs, possibly in most continents, for many years prior to its transmission to



humans.<sup>2</sup> Scientific studies have reported that the new flu virus contained segments from four different viruses, including the Russian flu that infected humans worldwide in the late 1970s.

Scientists pointed to children and young adults as the main risk groups, given that the older population had protective immunity resulting from prior experience with H1N1 strains, for example, the Russian flu. The new H1N1 virus sub-type was worrisome because it was very contagious and spread easily from one person to another and from one country to another. By June 2009, nearly 30,000 confirmed cases had been reported in 74 countries and WHO officially declared the world to be facing a new pandemic.

*"I have (...) decided to raise the level of influenza pandemic alert from phase 5 to phase 6. The world is now at the start of the 2009 influenza pandemic. (...) The virus is spreading under a close and careful watch. No previous pandemic has been detected so early or watched so closely, in real-time, right at the very beginning. The world can now reap the benefits of investments, over the last five years, in pandemic preparedness."*

(Excerpt of the declaration of Dr. Margaret Chan, Director-General of the World Health Organization<sup>3</sup>)

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<sup>2</sup> G., SMITH, D., VIJAYKRISHNA, J., BAHL, S., LYCETT et al. Origins and evolutionary genomics of the 2009 swine-origin H1N1 influenza A epidemic, *Nature*, 2009, No. 459, 1122-1125.

The WHO decision to declare a mild A/H1N1 influenza outbreak as a pandemic was received with some criticism in Europe. The Council of Europe was among the first institutions to call for a thorough investigation of the response to the A/H1N1 flu. It even accused WHO of proclaiming a "fake pandemic".<sup>4</sup> Additionally, a number of national bodies, including the French Senate<sup>5</sup>, scrutinised the A/H1N1 case. The influential British Medical Journal presented its concerns in an article published under the controversial title: WHO and the pandemic flu 'conspiracies'.<sup>6 7</sup>

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<sup>3</sup> M., CHAN, World now at the start of 2009 influenza pandemic, 11.06.2009 (Accessed: 10.10.2010, World Health Organization, [http://who.int/mediacentre/news/statements/2009/h1n1\\_pandemic\\_phase6\\_20090611/en/index.html](http://who.int/mediacentre/news/statements/2009/h1n1_pandemic_phase6_20090611/en/index.html)).

<sup>4</sup> Memorandum AS/Soc (2010)12 of 23 March 2010 of the Council of Europe. The handling of the H1N1 pandemic, more transparency needed. 23.03.2010, (Accessed: 14.10.2010, Council of Europe, [http://assembly.coe.int/CommitteeDocs/2010/20100329\\_MemorandumPandemie\\_E.pdf](http://assembly.coe.int/CommitteeDocs/2010/20100329_MemorandumPandemie_E.pdf)).

<sup>5</sup> Report No. 685 (2009-2010) of the Senate of the French Republic on La grippe A (H1N1)v : Retours sur "la première pandémie du XXIe siècle" (Accessed: 15.10.2010, French Senate, <http://www.senat.fr/rap/r09-685-1/r09-685-11.pdf>)

<sup>6</sup> D., COHEN, P., CARTER, WHO and the pandemic flu "conspiracies", *British Medical Journal*, Vol. 340, (2010), No. c2912.

<sup>7</sup> J., CHAN, ASEAN urges WHO to review pandemic alert levels, 22.10.2010 (Accessed: 11.03.2011, Channel News Asia, <http://www.channelnewsasia.com/stories/singaporelocalnews/view/1070903/1/.html>).

The abovementioned bodies specifically targeted the internal WHO processes that led to the decision to declare a pandemic. Several investigations revealed that the some members of the WHO decision-making body had strong ties with vaccine-producing companies.<sup>8</sup> This revelation was highly controversial, as it implied an increased risk of bias and led to the belief that it might have influenced the decision to proclaim a pandemic.

In the event, there was no strong scientific support of the WHO's declared estimate of two billion predicted infections. Indeed, by August 2010, more than a year after the declaration of the A/H1N1-pandemic, the number of cases had remained well below two billion and barely 19,000 people had died as a result of the virus.<sup>9</sup> Given the fact that the WHO announced in July 2009 that the counting of individual cases was no longer essential in countries with sustained community transmission, it is difficult to have a good indication of how many people were affected.<sup>10</sup>

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<sup>8</sup> D., COHEN, P., CARTER, WHO and the pandemic flu "conspiracies", *British Medical Journal*, Vol. 340, (2010), No. c2912.

<sup>9</sup> K., DRUMMOND, H1N1 declared over, experts ponder lessons, 10.08.2010. (Accessed: 12/12/2010, AOL News, <http://www.aolnews.com/2010/08/10/h1n1-declared-over-experts-ponder-pandemics-lessons/>).

<sup>10</sup> WORLD HEALTH ORGANIZATION, Changes in reporting requirements for pandemic (H1N1) 2009 virus infection, 16.07.2009. (Accessed: 21.10.2010, [http://www.who.int/csr/disease/swineflu/notes/h1n1\\_surveillance\\_20090710/en/index.html](http://www.who.int/csr/disease/swineflu/notes/h1n1_surveillance_20090710/en/index.html)).

WHO's task is a difficult one and this report is not the place to criticise it. However, its 2009 decision to declare a pandemic and the consequences of that decision raise a number of questions that are very relevant in this context. What explains the discrepancy between the projected impact and the actual impact? Is a pandemic declared too easily or are the models used by WHO inappropriate for predicting a pandemic's severity and extent? Can a pandemic threat be responded to without hitting the panic button?

### ***1.3 The definition of a pandemic at stake***

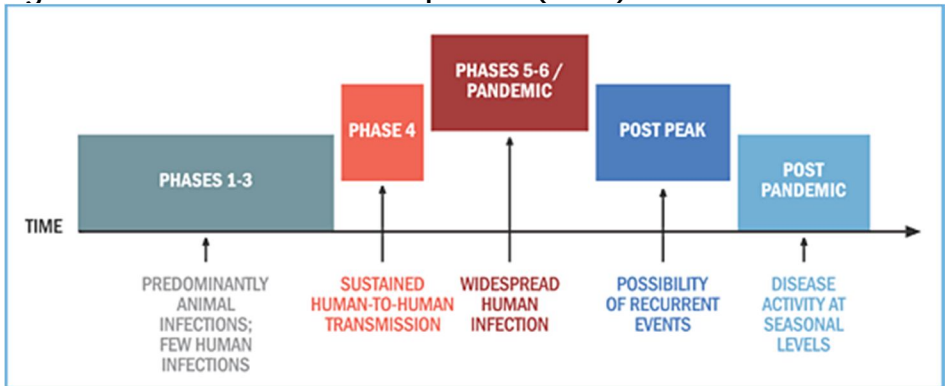
Founded in 1948, the WHO is the specialised agency of the United Nations (UN) that acts as a coordinating authority for international public health. Its main objective is the attainment the highest possible level of health by all people. The organisation is headed by a director-general (currently Margaret Chan).

It is at the discretion of the WHO, in the voice of its director-general, to declare a pandemic outbreak. In taking this decision, the director-general is advised by two expert groups. The Strategic Advisory Group of Experts (SAGE) serves as the principal advisory group for the development of policy related to vaccines and immunisation at a strategic level. An ad-hoc Emergency Committee provides special

advice on matters related to acute public health events and emergencies of international concern.

Taking into account the views of the different bodies, WHO takes a decision on the pandemic alert level of an infectious disease. It uses six pandemic alert phases to inform the world of the gravity of a threat. These phases reflect the progression of an influenza pandemic from the first appearance of a new virus to global occurrence.

**Figure 1. Pandemic Influenza phases (2009)**



Source: World Health Organization, Pandemic Influenza Preparedness and Response: A WHO Guidance Document (2009).

Raising the pandemic alert from phase 5-6 and declaring a pandemic has a number of important implications. In response to WHO declaring a pandemic, all countries affected by influenza should consider activating and implementing national pandemic plans covering the monitoring and reporting of infections, monitoring of

resources, ensuring the availability of vaccine and antiviral drugs, considering limitations on travel and mass gatherings, ensuring the sustenance of business and informing and educating the public.<sup>11</sup> As such, the activation of national pandemic plans has considerable implications in terms both of financial and human resources.

In order to learn from the 2009 pandemic, it is important to understand why a pandemic declaration was triggered in response to a disease that was mild and with a low mortality rate. For this, we must take a closer look at the mortality rate aspect. Prior to the A/H1N1 influenza virus, the WHO definition of pandemics stated:

*“An influenza pandemic occurs when a new influenza virus appears against which the human population has no immunity, resulting in several, simultaneous epidemics worldwide with enormous numbers of deaths and illness. With the increase in global transport and communications, as well as urbanisation and overcrowded conditions, epidemics due [sic] the new influenza virus are likely to quickly take hold around the world.”<sup>12</sup>*

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<sup>11</sup> EUROPEAN CENTRE FOR DISEASE CONTROL AND PREVENTION, Pandemic alert level 6: Scientific criteria for an influenza pandemic fulfilled, *Eurosurveillance*, Vol. 14, (2009), No. 23.

<sup>12</sup> C., SCHILLING, How U.N. redefined ‘pandemic’ to heighten alarm over H1N1 (Accessed: 10.10.2010, World Net Daily, <http://www.wnd.com/?pageId=115719>). This definition has been taken from a screenshot of the WHO website. This webpage was accessible until May 2009.

WHO changed the definition in connection with the A/H1N1 outbreak, omitting the words “enormous numbers of deaths and illness”. The definition currently reads:

*“A disease epidemic occurs when there are more cases of that disease than normal. A pandemic is a worldwide epidemic of a disease. An influenza pandemic may occur when a new influenza virus appears against which the human population has no immunity. With the increase in global transport, as well as urbanisation and overcrowded conditions in some areas, epidemics due to a new influenza virus are likely to take hold around the world, and become a pandemic faster than before. WHO has defined the phases of a pandemic to provide a global framework to aid countries in pandemic preparedness and response planning. **Pandemics can be either mild or severe in the illness and death they cause, and the severity of a pandemic can change over the course of that pandemic.**”<sup>13</sup>*

So, in the revised WHO definition the term ‘pandemic’ is defined only by the geographic spread of the disease, not, as previously, by spread *and* severity.

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<sup>13</sup> WORLD HEALTH ORGANIZATION, Global Alert and Response (GAR): Pandemic preparedness, s.d. (Accessed: 19.10.2010, <http://www.who.int/csr/disease/influenza/pandemic/en/index.html>).

Shortly after revising the definition, WHO published separate considerations for assessing the severity of an influenza pandemic.<sup>14</sup> The WHO framework comprises three variables that cover virological and epidemiological characteristics such as virulence, transmissibility, the vulnerability of a population and the capacity for response. However, this framework lacks a detailed methodology to assess severity.<sup>15</sup>

WHO has thus decided to take severity out of the definition of a pandemic and to make it subject to an assessment once a pandemic has been declared. In theory, this is a plausible approach because it allows for a more tailored response. There are, however, two major shortcomings to the new routine: first, there is no detailed methodology to assess the severity of a pandemic; second, it ignores the traditional meaning of the word pandemic. The general public may perceive a pandemic as something that is severe by definition. The media too tends to associate the word pandemic with disaster. This makes it difficult to apply a measured response once a pandemic has been declared.

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<sup>14</sup> WORLD HEALTH ORGANIZATION, Considerations for assessing the severity of an influenza pandemic, *Weekly Epidemiologic Record*, Vol. 84, (2009), No. 22.

<sup>15</sup> T., KAMAGAKI, H., OSHITANI, Influenza pandemic preparedness and severity assessment of pandemic (H1N1) 2009 in South-east Asia, *Public Health*, (2010), 124.



An obvious problem in connection with an actual outbreak that arose from changing the definition of pandemic was that national and regional response mechanisms were not adjusted to the new way of declaring a pandemic and assessing its severity. These were activated in response to the declaration of phase 5 or 6 of the pandemic outbreak scale - irrespective of its severity, or rather, assuming the outbreak would be severe.

Even if countries now adopt the new definition, WHO has made it harder for society to react in an appropriate manner. The changes to the definition of a pandemic have resulted in an increased risk of a mismatch between the severity of the pandemic and the response chosen.

Critical voices now call for a more diversified approach that covers the full existing range of pandemic realities. There is much to be gained from a more context-driven approach, as it would significantly improve preparedness for new pandemic threats, including the emergence of infectious agents other than influenza.

In short, the 2009 A/H1N1 scare has taught us that the international pandemic preparedness and response system is poorly prepared for multiple and diverse realities, while history teaches us that hardly any pandemic outbreak is ever similar to another. A brief historical overview of pandemics and their infectious agents follows.

## ***1.4 Pandemics and infectious agents***

A pandemic is an infectious disease on a global scale caused by microbes that spread. A microbe needs a set of favourable conditions before it can spread and cause an infectious disease. This set of favourable conditions is represented in the epidemiologic triangle, which has three vertices: the host, the agent, and the environment. All three have to be present in order for a disease to manifest itself.

The agent is the microbe that causes the disease and the host is the organism that harbours the disease. The environment consists of other external factors that cause or allow disease transmission. To prevent disease, one or more of these factors need to be altered.

Viruses are not the only microbes that can cause a pandemic outbreak. An infectious disease can be caused by many different agents. The most common known agents are, starting with the smallest, prions, viruses, bacteria, fungi, protozoa, helminths and ectoparasites.

**Prions** (proteinaceous infectious particles) are primarily built up as small strains of protein. They are not considered to be living matter. Prions are the cause of bovine spongiform encephalopathy (BSE), known as mad-cow disease in cattle and Creutzfeldt-Jacob disease in humans. All currently known prions affect the brain or other neurological tissue and are currently untreatable and universally

fatal.

**Viruses** are small infectious agents that can only replicate inside the living cells of organisms. They consist of two or three parts: a helical molecule, a protein coat and sometimes an envelope/wrapper. Viruses infect all types of organism: humans, animals, plants and even bacteria. Viruses are found in almost every ecosystem on earth and are the most abundant type of biological entity. Several well-known diseases are caused by viral agents, e.g., the common cold, influenza, rubella, measles, yellow fever, dengue fever, acquired immune deficiency syndrome (AIDS), severe acute respiratory syndrome (SARS), rabies, polio, hepatitis, herpes, smallpox, cowpox, varicella, mononucleosis, measles, mumps and hemorrhagic fevers (such as Ebola).

**Bacteria** are a large group of single-celled prokaryote <sup>16</sup> microorganisms. Unlike viruses, they do not need a living host to replicate. Bacteria come in many shapes, ranging from spheres (*cocci*) to rods (*bacilli*) and spirals (*spirochaetes*). Bacteria are present in every ecosystem on earth, growing in soil, water, deep in the earth's crust and oceans and in organic matter, plants, animals and humans. There are approximately ten times as many bacterial cells in and on the human body as there are human cells in the body. The vast majority of the bacteria in the body are harmless because they are controlled by the immune system. A few are even

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<sup>16</sup> Prokaryote cells lack a nucleus.

beneficial (e.g., probiotic flora). However, some species of bacteria are pathogenic, causing infectious diseases. Pathogens are classified through Gram staining<sup>17</sup> into either Gram-positive or Gram-negative bacteria. Human infectious diseases are mostly found within the Gram(+) and (-) cocci and Gram(+) and (-) bacilli groups. These cause a variety of infections such as urinary, digestive and respiratory tract infections, meningitis, sepsis, skin and soft-tissue infections and sexually transmitted diseases (STDs). Life-threatening infections such as anthrax, botulism, gangrene, diphtheria, tetanus, cholera, typhoid, whooping cough, gonorrhoea, plague, tuberculosis, syphilis and leprosy are caused by specific well-defined bacterial species.

**Fungi** are members of a large group of eukaryotic organisms that includes yeasts and moulds, as well as the more familiar mushrooms. Genetic studies have shown that fungi are more related to animals than to plants. The major difference with plants is that fungal cells have cell walls that contain chitin<sup>18</sup> instead of cellulose. Fungi are abundant worldwide, living in soil or dead matter, and are symbiotic with plants, animals and other fungi. Some species are pathogenic, causing skin and soft-tissue infections, urinary and respiratory tract infections, meningitis and sepsis.

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<sup>17</sup> Gram staining is a method of differentiating bacteria species into two large groups (Gram-positive and Gram-negative) with different characteristics of the cell wall.

<sup>18</sup> Chitin is what the external skeletons of crustaceans and insects are made of.

**Protozoa** form a (sub-)kingdom of microorganisms that are classified as non-fungal eukaryotic organisms. Acting mainly as parasites, they are a major component of the ecosystem. They host many pathogens for humans. Plasmodium species (malaria) and Trypanosoma species (sleeping sickness or chagas) cause extensive morbidity and mortality in Asia, Sub-Saharan Africa and Central and South America.

**Helminths** are a division of parasites that live inside their host (endoparasites). They are worm-like organisms that live and feed off living hosts, disrupting their metabolism and causing morbidity and even mortality in the long run. More than 2.5 billion people globally are infected with endoparasites, including tapeworms like Taenia and Echinococcus, flukes like Schistosoma (bilharzia), roundworms like Ascaris and hookworms.

**Ectoparasites** include ticks, maggots and mites that live outside their hosts. Infestations with ectoparasites are common in hospitalised patients. Although ectoparasites tend to be more troublesome from an infection control perspective than detrimental to patients, in immunosuppressed patients, they can be a source of serious morbidity.<sup>19</sup> In 1979, scabies, caused by the itch mite and transmitted by skin-to-skin contact, reached pandemic proportions.

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<sup>19</sup> J., SARGENT, *Hospital Epidemiology and Infection Control* (3rd Ed.), Philadelphia, Lippincott Williams & Wilkins, 2004.

In the USA this infestation was observed in patients of all ages and socioeconomic levels.<sup>20</sup>

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<sup>20</sup> M., ORKIN, H., MAIBACH, Scabies, a current pandemic, *Postgraduate Medicine*, Vol. 66, (1979), No. 52-62.

## ***1.5 Increased threats of pandemics - limits of hindsight and foresight***

### *1.5.1 Pandemics of the past*

The Greek historian Thucydides described one of the very first pandemics in recorded history. In 430 BC, during the Peloponnesian war between Athens and Sparta, a great pestilence wiped out more than 30,000 citizens of Athens.

The plague that raged in the 14<sup>th</sup> century, with its peak in Europe during the years 1348-1350, was probably the pandemic with the highest mortality rate in modern history. Over 75 million people worldwide were killed by this plague, which became known in history as the Black Death.<sup>21</sup>

The 20<sup>th</sup> century saw the outbreak of three influenza pandemics: in 1918, 1957 and 1968. All three have been named after their presumed sites of origin: the Spanish flu, the Asian flu and the Hong Kong flu, respectively.

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<sup>21</sup> J., N., HAYS, *Epidemics and pandemics: their impacts on human history*, Santa Barbara, ABC-Clio, 2005.

The Spanish influenza pandemic of 1918-1919 killed more people than World War I. Estimates range from 20 to 50 million casualties.<sup>22</sup>

With a global death toll estimated at around two million, the Asian flu of 1957 was much less severe than the Spanish flu of 1918. Its significance was that it represented the first time that a rapidly spreading influenza virus was available for immediate laboratory investigation.<sup>23</sup>

The 1968 Hong Kong flu killed approximately two million people. But important differences between countries were noted in the pattern of illness and death. In Japan, the outbreaks were small, scattered and desultory until the end of 1968. More striking were the high illness and death rates in the USA. In Europe increased illness initially occurred with a very low mortality rate in 1968 and increased death rates were not seen until the second year of the pandemic.<sup>24</sup>

The 20<sup>th</sup> century pandemics were caused by three different antigenic subtypes of influenza A virus: H1N1 (Spanish flu), H2N2 (Asian flu),

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<sup>22</sup> M., BILLINGS, The Influenza Pandemic of 1918, 1.02.2005 (Accessed: 30.10.2010, Human Virology Stanford University, <http://virus.stanford.edu/uda/>).

<sup>23</sup> E., KILBOURNE, Influenza Pandemics of the 20<sup>th</sup> century, *Emerging Infectious Diseases*, Vol. 12, (2006), No. 1, 9-11.

<sup>24</sup> *Ibid.*



and H3N2 (Hong Kong flu) respectively. The 2009 influenza pandemic was caused by an A/H1N1 virus.

**Table 1. Characteristics of the three 20<sup>th</sup> century pandemics**

	Case fatality rate	Estimated mortality	GDP loss (percentage change)
1918-1919 Spanish flu	2-3 %	20-50 million	- 16.9 to 2.4
1957-1958 Asian flu	<0.2 %	1-4 million	- 3.5 to 0.4
1968-1969 Hong Kong flu	<0.2 %	1-4 million	-0.4 to (-1.5)

Source: World Health Organization, Pandemic Influenza Preparedness and Response: A WHO Guidance Document (2009).

The first decade of the 21<sup>st</sup> century witnessed a remarkable number of pandemic outbreaks. The outbreak of SARS triggered a global wave of concern in 2002 and 2003. SARS infected more than 8,000 people, 776 of whom died.<sup>25</sup> This represented a mortality rate of nearly 10%.<sup>26</sup> Although SARS did not have an overwhelming global impact, the psychological fear effect made several countries take

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<sup>25</sup> CENTRE FOR DISEASE CONTROL AND PREVENTION (CDC), Basic information about SARS, 3.5.2005 (Accessed: 07.10.2010, <http://www.cdc.gov/ncidod/sars/factsheet.htm>).

<sup>26</sup> KYODO NEWS INTERNATIONAL, SARS mortality rate tops 9%, death toll reaches 745, *Asian Economic News*, 02.06.2003.

drastic measures, including extensive measures of containment and quarantine.

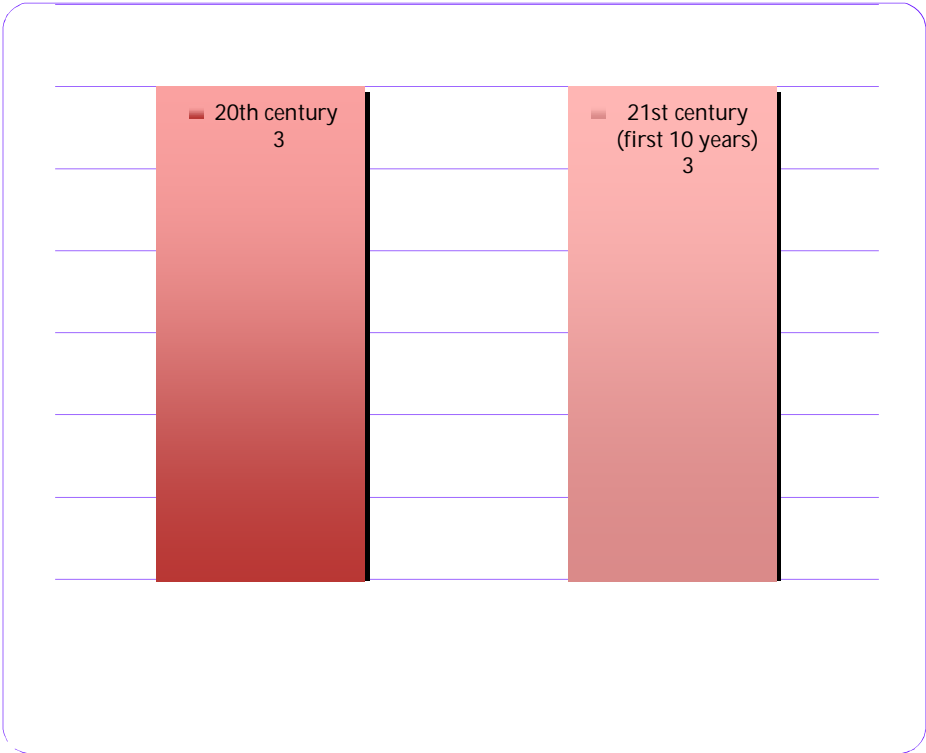
Only one year later, the outbreak of H5N1 influenza zoonosis, also known as avian or bird flu, was announced. Again, although the number of cases was very low (486), virulence was high. The mortality rate rose to almost 60%, with half of the cases reported in Egypt, Indonesia and Vietnam. It was classified as a pandemic due to the geographical spread of the virus. The virus spread from birds to humans but fortunately showed poor sustainability within human communities; in fact, horizontal transmissibility was never proven. Avian flu is still endemic in some parts of the world and a mutation of the virus to enable horizontal transmission is still considered a possibility. In an effort to halt the spread of the disease, comprehensive quarantine measures, especially for domesticated birds and birds in captivity, were adopted around the world.<sup>27</sup>

Lastly, on the 11<sup>th</sup> of June 2009, WHO announced alert phase 6 for the A/H1N1 pandemic, making this the third pandemic of the first decade of the 21<sup>st</sup> century. Despite H5N1, WHO considers the 2009 A/H1N1 pandemic to be the first influenza pandemic of the 21<sup>st</sup> century.

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<sup>27</sup> WORLD HEALTH ORGANIZATION, Avian Influenza 'Bird Flu', 02.2006 (Accessed: 08.10.2010, [http://www.who.int/mediacentre/factsheets/avian\\_influenza/en/](http://www.who.int/mediacentre/factsheets/avian_influenza/en/)).

Figure 2. Number of pandemic outbreaks in the 20<sup>th</sup> and 21<sup>st</sup> century<sup>28</sup>



<sup>28</sup> There is some debate about whether or not the figure of three pandemics in the 20<sup>th</sup> century actually covers all pandemic outbreaks of the century. Just as an example, AIDS is not included as an epidemic.

Whether there will be more pandemic outbreaks in the 21<sup>st</sup> century is obviously difficult to say: However, besides WHO, several other major international actors point in the direction of an increased threat of infectious diseases and pandemics:

- The European Environment Agency claims in its European Environment State and Outlook of 2010 that the risk of a new pandemic is an important global megatrend relevant for the European environment. It foresees that the risk of exposure to new, emerging and re-emerging diseases, to accidents and to new pandemics grows with increased mobility of people and goods, climate change and poverty. <sup>29</sup>
- The United States Intelligence Council points to the risk of a pandemic outbreak in its Global Trends 2025 report.<sup>30</sup>
- The Fifth Global Progress Report on animal and pandemic influenza of the UN and the World Bank states that emerging diseases are increasing, intensifying and moving into or spreading to new populations for the first time, and it is predicted that new pathogens will continue to emerge in

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<sup>29</sup> EUROPEAN ENVIRONMENT AGENCY, *The European Environment State and Outlook: Assessment of Global Megatrends*, Copenhagen, European Environment Agency, 2010, 19-24.

<sup>30</sup> UNITED STATES NATIONAL INTELLIGENCE COUNCIL, *Global Trends 2025: A transformed world*, Washington, US Government Printing Office, 2008, 75-76.

domestic and wild animal populations at the rate of at least two per year. The crowding of three major epidemiological events into the first decade of the new century – SARS, H5N1 and A/H1N1 – is an indication of the rate at which threats may continue to arise.<sup>31</sup>

Although it is safe to assume that the threat of a pandemic outbreak is increasing, the timing, nature and epidemiology cannot be predicted. Alternatives to prediction must be considered in order to improve preparedness. Traditionally foresight studies have been used for this purpose, but can the existing foresight studies on pandemic preparedness help us to prepare for a pandemic outbreak in the face of a growing threat?

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<sup>31</sup> UNITED NATIONS SYSTEM INFLUENZA COORDINATION AND THE WORLD BANK, *Animal and Pandemic influenza, 5th Global Progress Report*, New York, UNSIC, 2010, 100.

### 1.5.2 A review of existing foresight studies on pandemics

Several universities and research institutes across Asia and Europe have conducted foresight studies on pandemic preparedness in recent years.

#### **Foresight infectious diseases: preparing for the future (UK, 2006)<sup>32</sup>**

The aim of the project was to produce a long-term vision for the detection and identification of infectious diseases in plants, animals and humans, to highlight possible issues for a 10-25 year timeframe. It aimed to incorporate successful research material and build on the best work by others in this area.

A starting point was to generate a vision of future threats from infectious diseases and the factors driving them. Drivers were defined as factors that change the state of an infectious disease system, impacting on sources and pathways and affecting the nature of future disease outcomes or the probability of their occurrence.

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32 OFFICE OF SCIENCE AND INNOVATION, *Foresight Infectious Diseases: preparing for the future Executive Summary*, London, Office of Science and Innovation, 2005. See <http://www.bis.gov.uk/foresight/our-work/projects/published-projects/infectious-diseases>

The project helped frame G8 priorities and declarations in the area of infectious diseases. It also developed a proposal for a pan-African network that would develop capacity to manage future infectious diseases of humans, animals and plants. Finally, it informed the long-term policy and strategies of key European and multinational organisations, e.g., in the areas of human and animal health and the impact of infectious diseases on ecosystems.

### **Estimates of the impact of a future influenza pandemic in China (2009)<sup>33</sup>**

This study estimates the effects of a future influenza pandemic in China by examining pandemic scenarios of varying severity based on the 1918 and 1968 pandemics. It also describes the time distribution of cases during a first pandemic wave. A Monte Carlo simulation<sup>34</sup> was used to conduct this study.

Death rates, hospitalisations and outpatient visits for 1918-like and 1968-like pandemic scenarios, data from the literature and expert

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<sup>33</sup> H., YU, L., FENG, Z., PENG, Z., FENG, D., K., SHAY, W., YANG (2009), Estimates of the impact of a future influenza pandemic in China, *Influenza and Other Respiratory Viruses*, Vol. 3, (2009), No. 5, 223–231. See <http://onlinelibrary.wiley.com/doi/10.1111/j.1750-2659.2009.00093.x/abstract>

<sup>34</sup> A Monte Carlo simulation is a computerised mathematical technique that allows people to see all the possible outcomes of their decisions and assess the impact of risk, allowing for better decision making under uncertainty.

opinions were used to estimate four health outcomes: deaths, hospitalisations, outpatient visits and clinical illnesses for which medical care was not sought.

The study estimates that a scenario like that of 1968 in today's China would result in 460,000 to 700,000 deaths and 1.94 to 2.27 million hospitalisations. A scenario like that of 1918 would result in 4.95 to 6.95 million deaths and over 20.8 to 22.7 million hospitalisations.

The study acknowledges several limitations. Methodologically, the Monte-Carlo model is a deterministic model, which means that it can only provide an estimate of the overall impact of a future pandemic and cannot describe or predict the disease spread through a population. In addition, the study only simulates a first pandemic wave, although a pandemic may cause two or three waves of disease.

As to the outcome, the study indicates it may overestimate the impact of the next pandemic influenza, particularly for a severe 1918-type pandemic. Improvements since 1918 in prevention, control and treatment measures could result in lower hospitalisation and mortality rates for a future severe pandemic, although it has to be said that data to directly support this contention is scant. Moreover, the study does not assess the effects of influenza vaccines and antiviral drugs, the two most important medical



interventions for reducing illness and deaths during a pandemic.

### **Infectious diseases China project (Foresight, 2009)<sup>35</sup>**

This project was based on a simple but novel methodology for identifying possible future infectious disease trends in animals and humans in China – a priority concern to the Chinese authorities. It used a model of disease drivers, namely, social, economic, biological or environmental factors that affect disease outcomes by changing the behaviour of diseases, sources or pathways. Nine families of drivers were adapted to Chinese circumstances and matrices were constructed to identify the likely relationship of single infectious diseases or families of diseases to the drivers. The likely future trends in those drivers in China were determined by interviews with 36 independent Chinese experts.

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<sup>35</sup> A., NICOLL, J., HUANG, Z., XIE, THE FORESIGHT CHINA PROJECT GROUP, Foresight Infectious Diseases China Project - A novel approach to anticipating future trends in risk of infectious diseases in China: methodology and results from an initial application, *Eurosurveillance*, Vol.14, (2009), No. 27, 1-11. See <http://www.eurosurveillance.org/viewarticle.aspx?articleid=19261>

## Foresight exercise on infectious diseases in Canada (2005)<sup>36 37</sup>

Under this project a large segment of the Canadian infectious disease community was telephone-surveyed in a Foresight exercise to identify key considerations and future needs.

The study presents a distillation and organisation of thoughts, ideas and suggestions about the present and future from many participants with differing backgrounds and perspectives. The information was collected from credible sources and individuals who are considered leaders in their fields and whose opinions should be considered a 'pulse-check' on the status of infectious disease services and research.

The information offered by the participants covered a range of issues relevant to their current and expected future work and research. Many issues were worthy of consideration for their potential impact on the threats from infectious diseases.

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<sup>36</sup> NATIONAL COLLABORATING CENTRE FOR INFECTIOUS DISEASES OF CANADA, Foresight exercise on infectious diseases in Canada future trends and emerging issues, 12.2005, (Accessed: 08.03.2010, NCCID, [http://www.nccid.ca/en/files/Foresight\\_Final\\_Report.pdf](http://www.nccid.ca/en/files/Foresight_Final_Report.pdf)).

<sup>37</sup> The insights of studies not covering Asia or Europe are equally relevant given the global dimension of pandemics and infectious diseases.

### *1.5.3 Shortcomings of existing foresight studies*

Each of these studies offers information on the future of infectious diseases, pandemics and pandemic preparedness. Yet they fall short of grasping a number of future critical challenges for pandemic preparedness.

Each of the three outbreaks of the last decade was different in nature and scope. SARS was a small but aggressive pandemic, while A/H1N1 was widespread but not very lethal. Such important differences are largely overlooked by existing foresight studies, which tend to conclude by identifying a series of factors or forces that are critical for pandemic preparedness - undoubtedly an important and invaluable step. But by solely identifying factors, these studies stop short of reasoning on their impact in the varying contexts in which pandemics can develop. The complexity of future pandemic preparedness lies in the interplay between these factors and possible pandemic realities.

Information on the past provides no guarantees for the future, as was proved by the 2009 A/H1N1 outbreak. Foresight studies based on past data have trouble capturing the fact that many key factors in the equation may be subject to drastic change in the future. Society, authorities, economies and technologies are becoming more complex and the changes will greatly affect the context in which pandemics spread and the instruments and realm of influence of

actors dealing with pandemics. In other words, they will greatly affect key aspects of our ability to be prepared for, and respond to, pandemics.

#### *1.5.4 WHO recommendations and actions for pandemic preparedness*

Each WHO-phase of a pandemic has different implications for different sectors and their preparedness activities. Table 2 illustrates the current WHO classification of pandemic preparedness recommendations. The recommended actions are organised into five basic components of preparedness and response:

1. Planning and coordination
2. Situation monitoring and assessment
3. Communications
4. Reducing the spread of disease
5. Continuity of health care provision.

Table 2. WHO summary of recommended actions for pandemic preparedness and response

PREPAREDNESS COMPONENTS	PHASES				
	1-3	4	5-6	POST PEAK	POST PANDEMIC
PLANNING AND COORDINATION	<b>Develop, exercise, and periodically revise national influenza pandemic preparedness and response plans.</b>	Direct and coordinate rapid pandemic <b>containment</b> activities in collaboration with WHO to limit or delay the spread of infection.	Provide <b>leadership and coordination to multisectoral resources</b> to mitigate the societal and economic impacts.	Plan and coordinate for <b>additional resources and capacities</b> during possible future waves.	<b>Review</b> lessons learned and share experiences with the international community.  <b>Replenish</b> resources.
SITUATION MONITORING AND ASSESSMENT	<b>Develop</b> robust national <b>surveillance</b> systems in collaboration with national animal health authorities, and other relevant sectors.	<b>Increase</b> surveillance. Monitor containment operations. Share findings with WHO and the international community.	<b>Actively monitor and assess</b> the evolving pandemic and its impacts and mitigation measures.	<b>Continue</b> surveillance to detect subsequent waves.	<b>Evaluate</b> the pandemic characteristics and situation monitoring and assessment tools for the next pandemic and other public health emergencies.
COMMUNICATIONS	<b>Complete</b> communications planning and initiate <b>communications</b> activities to communicate real and potential risks.	Promote and communicate recommended <b>interventions</b> to prevent and reduce population and individual risk.	Continue <b>providing updates</b> to general public and all stakeholders on the state of pandemic and measures to mitigate risk.	<b>Regularly update</b> the public and other stakeholders on any changes to the status of the pandemic.	Publicly <b>acknowledge</b> contributions of all communities and sectors and communicate the lessons learned; <b>incorporate</b> lessons learned into communications activities and planning for the next major public health crisis.
REDUCING THE SPREAD OF DISEASE	<b>Promote beneficial behaviours</b> in individuals for self protection. Plan for use of pharmaceuticals and vaccines.	Implement rapid pandemic <b>containment</b> operations and other activities; collaborate with WHO and the international community as necessary.	<b>Implement</b> individual, societal, and pharmaceutical measures.	<b>Evaluate</b> the effectiveness of the measures used to update guidelines, protocols, and algorithms.	Conduct a <b>through evaluation</b> of all interventions implemented.
CONTINUITY OF HEALTH CARE PROVISION	<b>Prepare</b> the health system to <b>scale up</b> .	Activate <b>contingency</b> plans.	<b>Implement</b> contingency plans for health systems at all levels.	<b>Rest, restock</b> resources, <b>revise plans, and rebuild</b> essential services.	<b>Evaluate</b> the response of the health system to the pandemic <i>and share the lessons learned.</i>

Source: World Health Organization, Pandemic Influenza Preparedness and Response: A WHO Guidance Document (2009).

Actions taken during phases 1-3 are aimed at strengthening pandemic preparedness and response capacity at all levels. The overarching goal of actions taken during phase 4 is containing the new virus within a limited area or delaying its spread. If successful, valuable time can be gained to implement interventions including the use of vaccines. During phases 5-6, actions shift from preparedness to global response to reduce the impact of the pandemic. Actions during the post-peak period focus on addressing the health and social impact of the pandemic as well as preparation for possible future pandemic waves. The focus of the post-pandemic period is restoration of normal health and social functions while addressing the long-term health and social impact of the pandemic.

The WHO stresses the importance of a whole-of-society approach or multi-sector approach to pandemic preparedness, in which all sectors such as the media, civil society and the business sector, and not just the health sector, play a significant role. Capacity development across sectors for preparedness and mitigation is at the heart of pandemic preparedness and covers anything from business contingency plans to coordination and dissemination activities.<sup>38</sup>

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<sup>38</sup> WORLD HEALTH ORGANIZATION, *Whole-of-Society Pandemic Readiness, WHO guidelines for pandemic preparedness and response in the non-health sectors*, Geneva, World Health Organization Press, 2009.

While all sectors of society are involved in pandemic preparedness and response, national governments are the most obvious coordinators of preparedness activities. WHO suggests that central governments should:

- Identify, appoint, and lead the coordinating body for pandemic preparedness and response.
- Enact or modify legislation and policies required to sustain and optimise pandemic preparedness, capacity development, and response efforts across all sectors.
- Prioritise and guide the allocation and targeting of resources to achieve the goals as outlined in a country's Pandemic Influenza Preparedness Plan.
- Provide additional resources for national pandemic preparedness, capacity development, and response measures.
- Consider providing resources and technical assistance to countries experiencing outbreaks of influenza with pandemic potential.<sup>39</sup>

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<sup>39</sup> *Ibid.*

## ***1.6 Pandemic preparedness in Asia and Europe: a motley patchwork***

Pandemic preparedness in Asia and Europe is a complex patchwork. Differences in the level of development as well as differences in national and international preparedness structures make it difficult to assess how adequate pandemic preparedness in Asia and Europe is.

Some of the poorer Asian countries have plans to make plans, while some of the richer Asian countries and most European countries have fairly well developed national preparedness and response systems. All countries, however, focus on influenza-type epidemics; none, as yet, have a system that can adequately adjust their response to the severity of an epidemic; and hardly any adopts a truly multi-sector approach. International coordination is more developed in Europe than in Asia but, as we will see below, in its current form this is not always a blessing.



### *1.6.1 A brief overview of Asian and European pandemic preparedness*

## **Asia**

Within Asia, there is a huge discrepancy between developed and developing countries in terms of pandemic preparedness. In developed countries or regions, such as Hong Kong or Japan, preparedness plans include comprehensive guidance manuals for key institutions and facilitating the development and implementation of national responses to pandemic influenza. Overall, these plans correctly address WHO's five basic components of preparedness and response. The plans also address less essential criteria.<sup>40</sup>

The plans of developing countries in Asia show a rather different picture. Countries like Lao PDR, Cambodia, China and Thailand have, in recent years, developed national governance on pandemic preparedness as well as national pandemic influenza preparedness plans; however, these plans are developmental policy guides aimed at developing capacity in the future. In these countries, the focus is on surveillance and rapid containment of poultry-related

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<sup>40</sup> R., COCKER, S., MOUNIER-JACK, Pandemic influenza preparedness in the Asia-Pacific region: An analysis of selected national plans, 01.04.2006 (Accessed: 23.10.2010, London School of Tropical Medicine, [http://www.lshtm.ac.uk/centres/ecohost/public\\_health/pandemic/pandemic\\_influenza\\_preparedness\\_in\\_the\\_asia\\_pacific\\_region.pdf](http://www.lshtm.ac.uk/centres/ecohost/public_health/pandemic/pandemic_influenza_preparedness_in_the_asia_pacific_region.pdf)).

transmission, while preparation for later pandemic stages or different pandemic scenarios is limited.<sup>41</sup>

A few examples illustrate the differences in preparedness. In Lao PDR and Cambodia, stockpiles of antivirals cover 1% or less of the population, whereas WHO recommends stockpiles of antivirals for 20% of the population. Whereas most developed countries have explicit staff and hospital surge capacity plans, surge capacity in developing countries is often limited to hospital beds, not to extra staff.<sup>42</sup>

This discrepancy can, in essence, be explained by the health system context. The level and form of pandemic preparedness depend on existing health system arrangements, particularly its governance, resources and existing service provision patterns. There tends to be a positive correlation between pandemic preparedness and health system provisions in a country: the better the health system, the better a country is prepared for a pandemic outbreak.

Developing countries or countries with limited domestic resources rely heavily on external funding for pandemic preparedness activities. Given that the focus of pandemic preparedness for less

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<sup>41</sup> *Ibid.*

<sup>42</sup> P., HANVORNVONGCHAI, W., ADISASMITO, et al., Pandemic influenza preparedness and health systems in Asia: results from rapid analysis in 6 Asian countries, *British Medical Journal Public Health*, Vol.322, (2010), No. 10.

developed Asian countries is on surveillance and rapid containment, their health system is likely to encounter serious difficulties if a pandemic expands beyond the early containment phase. In other words, pandemic mitigation in countries with limited health system resources is likely to be a major challenge. Conversely, investments in pandemic preparedness in countries with limited health systems can contribute to improving surveillance, laboratory capacity, monitoring, evaluation and public communications.

Another problem is that many Asian countries use terminology that is not coherent with the terminology used by WHO. The phases described in the operational and strategic plans in national pandemic influenza programmes, for instance, do not always mirror the WHO taxonomy.

On a regional level, there are a number of initiatives in Asia. SARS in 2003 affected many member countries of the Association of Southeast Asian Nations (ASEAN). Ever since, ASEAN has strongly promoted regional cooperation to combat emerging infectious diseases and promote pandemic preparedness. One of its initiatives is the ASEAN Technical Working Group on Pandemic Preparedness and Response (ATWGPPR), a regional group that aims to narrow intra-regional gaps in state-level pandemic response. The ATWGPPR is developing, for instance, ASEAN non-health indicators for pandemic preparedness and response. These can be used as the minimum required standard applicable to the entire region to

monitor the progress of national pandemic planning. Moreover, the ATWGPPR has conducted the first in the world regional table top exercise for pandemic preparedness in Phnom Penh in August 2010, which has delivered recommendations for the improvement of regional pandemic preparedness.

## Europe

The picture of pandemic preparedness in Europe is somewhat different from that of Asia. Since the 2005 H5N1 bird flu, the EU institutions and member states have made progress in strengthening European preparedness. Member states and the European Commission have all produced pandemic influenza preparedness or response plans. Many of these are available in the public domain. All EU member states have moved on from the stage of preparing plans to making them operational.<sup>43</sup>

The European Centre for Disease Prevention and Control (ECDC) was established in 2005. It works in partnership with national health protection bodies to strengthen and develop EU-wide disease surveillance and early-warning systems.

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<sup>43</sup> EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL, Technical report: Pandemic influenza preparedness in the EU, Stockholm, European Centre for Disease Prevention and Control, 2007.

Although the ECDC can act on its own initiative when outbreaks of contagious illnesses of unknown origin threaten the EU, it primarily tries to bridge the tasks and responsibilities of the member states, the EU institutions and relevant international organisations.

Enhanced European cooperation has also made it possible to work towards a European Influenza Surveillance Network (EISN), which proved to be very useful during the A/H1N1 pandemic in 2009.

A strong European dimension in pandemic preparedness makes coordination complex, however. The A/H1N1 outbreak proved that information sharing is not yet optimal. Despite obligations under international health regulations and EU decisions to share early analyses from the first affected countries, this did not always happen during the recent outbreak. This was most likely due to people simply being too busy to decide what could and should be shared with other countries or was perhaps due to epidemiologists not having sufficient confidence in their early data.

Despite being arguably well-prepared for a pandemic outbreak, the ECDC acknowledges that the existing (national and EU) preparedness plans and systems need to be revised to build in flexibility so that they can be adapted rapidly to differing types and severity of crisis.

In sum, while pandemic surveillance is a global responsibility, pandemic response and preparedness is largely a national affair, both in Asia and Europe. Both world regions, however, do share a number of weaknesses in pandemic preparedness. One problem in both regions is that multi-sector pandemic preparedness plans are effectively only health sector preparedness and national response plans. Involvement of other sectors is still largely lacking. Additionally, the most recent pandemic influenza pandemic has taught both world regions that the definitions of the severity of a pandemic need to be revised in order to better tailor response. Finally, even the best developed plans are biased towards influenza epidemics and do not cover other known and, perhaps more importantly, unknown infectious agents.

### ***1.7 The need for a different approach to pandemic preparedness in Asia and Europe***

The previous section briefly sketched the current state-of-play of pandemic preparedness in Asia and Europe. Both Asia and Europe have come a long way in preparedness since the outbreak of SARS in 2002 and the avian flu in 2005. Almost every country now has a national pandemic preparedness plan in place and invests in pandemic preparedness. Moreover, increased regional cooperation and coordination has strengthened pandemic preparedness across regions and borders.

As such, it is fair to say that when A/H1N1 appeared in 2009 the world was better prepared for a pandemic than ever before in history. But as we saw earlier, it was prepared for a different kind of event than actually occurred.

The outbreak of the 2009 A/H1N1 flu demonstrated an important flaw in the current pandemic preparedness architecture: a mismatch between outbreak severity and response. In the case of A/H1N1, some measures were taken that in retrospect had not been necessary given the modest character of the outbreak. The absence of effective severity assessment made it difficult for countries to respond appropriately.

A/H1N1 was a mild pandemic to which the world overreacted. The next pandemic may be much more severe and the current response plans may not be accurate enough to mitigate its impact. In the case of A/H1N1, a lot of money was spent but lives were saved. The same weakness might have the opposite effect the next time: insufficient resources may be mobilised and the death toll may be much higher.

In the aftermath of the A/H1N1 pandemic, Zsuzsanna Jakab, WHO's Regional Director for Europe, admitted that the pandemic preparedness architecture needed to be more flexible to respond to different realities.

*“Better preparedness for multiple scenarios required not only preparing for the worst but also adapting quickly to better outcomes. Flexibility of response to a health crisis should be embedded in preparedness plans.”<sup>44</sup>*

The existing foresight studies on pandemic preparedness all make valuable contributions to improving pandemic preparedness but do not help us prepare for different future scenarios.

A different approach to pandemic preparedness is needed, one in which the strategic handling of a pandemic outbreak is based on comprehensive scenarios. Pandemic preparedness and pandemic response have to become more fit-for-purpose.

Preparing for different scenarios minimises the possibility of surprises and makes it possible to respond more appropriately to a pandemic outbreak.

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<sup>44</sup> Z., JAKAB, Learning from the influenza pandemic, 05.07.2010 (Accessed: 20.08.2010, World Health Organization, Regional Office for Europe, <http://www.euro.who.int/en/what-we-do/health-topics/diseases-and-conditions/influenza/news2/news/2010/07/learning-from-the-influenza-pandemic>).



# 2 Future scenarios and dynamic strategies: the ASEF-ASAP approach and process

## *2.1 A sophisticated approach to foresight and preparedness*

In order to prepare for a new pandemic, society needs to look beyond tomorrow and, in order to prepare adequately, it must take into account new and unfamiliar pandemic outbreaks. As we argued in the preceding chapter, society needs to understand the different contexts in which it may have to face a pandemic. The implications for preparatory work were the subject of ASEF-ASAP's scenario building exercise.

### *2.1.1 ASEF-ASAP scenarios: no predictions, no visions*

Foresight is the art and science of looking into the future. Many foresight instruments and studies use knowledge of the past to predict the future by means of expert judgement, quantitative modelling projections or otherwise. In Chapter 1 we saw that the problem with these approaches is that they only capture what is

already known. What is not yet known and uncertain typically falls beyond the scope of existing foresight studies.

Unfortunately it is exactly what we do not know that tends to take us by surprise. We saw this in different ways with both the A/H1N1 outbreak and previous pandemics. If we want to be better prepared for future pandemics, we have to account for the unknown. This can be done through scenario planning. Scenario planning is used by organisations and companies around the globe for many different kinds of projects. Using this approach, not just one but a set of different futures for pandemic preparedness can be developed. This is exactly what the ASEF-ASAP project did.

Each future scenario tells a distinct story about an imaginary, yet specific, relevant and plausible context for future pandemic preparedness, describing different settings for pandemics and for preparedness and response. These future settings provide a testing ground for checking existing plans and approaches and for developing new and targeted actions.

It is very important to note that these scenarios do not aim to predict the future. None of the scenarios will materialise in exactly the way it is described. But if the scenarios are well constructed, they will, between them, include all the elements that the future may bring. The ensuing argument is that if actors across Asia and Europe prepare for all the scenarios, then they will be prepared for the future, whatever shape it may take.

The strategic aim of scenarios stands in stark contrast to visions. Neither the ASEF nor any of the people involved in this project have stated that any of the scenarios developed here are desirable. The scenarios are about what might happen, not what we want to happen. They serve to help us prepare for the uncertainty of the future. .

### *2.1.2 The building blocks of the ASEF-ASAP scenarios*

The ASEF-ASAP scenarios are built on the uncertainty of key developments that determine the future of pandemic preparedness in Asia and Europe. Scenarios capture and link different factors and developments. Combining these sets of stories about the future enables possible developments to be visualised. A number of elements serve as key building blocks in the process of developing scenarios.

**Time horizons** define how far scenarios look into the future. The ASEF-ASAP scenarios cover a period of 30 years with a time horizon from 2010 to 2040.

**Driving forces** are the main determinants that influence changes in the environment of pandemic preparedness. They are factors that have a strong influence on how the future may unfold.

**Uncertainties** refer to the different ways in which driving forces may affect the future.

For example, climate change may be a driving force for migration. An uncertainty related to this driving force could be the speed at which the consequences of climate change materialise. Will the world be faced with abrupt and severe draughts leading to possible sudden emigration (polarity A) or will the earth be subject to a slow, steady increase in temperatures and slowly developing new migration patterns (polarity B)?

In the ASEF-ASAP scenarios, 15 driving forces were identified and analysed for uncertainties.

**Scenario logics** are established on the basis of key uncertainties. One polarity of a key uncertainty is combined with one or more polarities of other key uncertainties. In ASEF-ASAP, this led to a scenario logic differentiating three scenarios, which we called Grey Paradise, Mosalnc.and Glocal Blocs . Scenario logics explain the differences between the scenarios at the most abstract level.

Finally, **storylines** describe the dynamics of the factors developing and the events occurring in the scenario. Storylines are narratives that combine and concentrate the vast amount of possibilities into a set of tangible futures.

## ***2.2 The participatory, multi-stakeholder process***

A complex issue such as pandemic preparedness requires a holistic approach and innovative ways of thinking. Such holistic and innovative dynamics can be created when diverse stakeholders are brought together to learn together and share experiences from their different fields of expertise. The effectiveness of pandemic preparedness is the sum of the commitment and capacity of all stakeholders to turn future scenarios into concrete plans and action.

Vital to the development of such commitment and capacity is a truly participatory dialogue between stakeholders from different sectors. Participation means that the stakeholders involved are not merely asked for their opinions but that they are directly involved in the creation of the scenarios and the strategies.<sup>45</sup>

As the promoter of greater mutual understanding between Asia and Europe through intellectual and cultural exchange, the ASEF with its ASEF-ASAP project has created a unique platform for a participatory approach to multi-sector pandemic preparedness.

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<sup>45</sup> M., GRAMBERGER, *Citizens as partners: OECD handbook on information, consultation and public participation in policy making*, Paris, OECD Development Centre, 2001.

### *2.2.1 Stakeholder selection*

A stakeholder identification process was designed to select a comprehensive set of stakeholders for the project. The first step in this process entailed a mapping of stakeholders, performed on the basis of a defined set of selection criteria, the elements of which are set out below.

#### **Equal representation of both Asia and Europe**

To do justice to the very diverse nature of both continents, the ASEF-ASAP project strived to have an equal representation of both Europeans and Asians in the stakeholder panel.

Members of the panel had to cover the different geographic, economic and cultural regions of both Asia and Europe. In practice, this meant that the stakeholder panel included people from Northern Europe, Southern Europe, Western Europe and Eastern Europe for the European group and people from North-East Asia, Southeast Asia and South Asia.

#### **Representation of relevant strata and sectors of society**

The multi-sector character of the ASEF-ASAP project was ensured by an equal representation of the following four main stakeholder categories: government and public authorities; civil society (including non-governmental organisations (NGOs) and the

media); the business sector; and the health sector, including related professions and experts.

On the basis of these criteria, a large number of stakeholders were identified covering each of the four mentioned categories in all the regions of Asia and Europe. From this list, a stakeholder panel of 26 high-level representatives was selected.

In this final selection, ASEF strived to have an equal representation of men and women and to have representatives covering both urban and rural areas and disadvantaged and minority groups. This was done, not to be politically correct, but to guarantee that as many different points of view were taken into account when considering particular driving forces and uncertainties.

In order to ensure continuity and quality of outcome, stakeholder panellists were asked to attend all three project workshops, with 16 of the initial 26 participants attending all three.

The exact composition of the resulting stakeholder panel can be found at the end of this document.

### *2.2.2 Tweaking the mixture for added value*

The stakeholders developed the majority of the building blocks for the scenarios. They were guided by expert facilitators in scenario development. The facilitators designed the process and guided panel members in scenario development, ensuring the active involvement of all participants during the workshops.

The project deliberately mixed technical and non-technical experts in the panel of stakeholders in a common dialogue on pandemic preparedness. This extended the angle of view in all directions, ensuring that the widest possible range of factors would be taken into account.

Putting together people from all walks of life with sometimes confronting views ensured the blend that was needed to go the extra mile: beyond the obvious and outside the comfort zone of individual experts but with the benefit of their specialist expertise.

A common understanding among experts and non-experts on the matter of pandemics was achieved by mixing the expertise of different stakeholders in all steps of the process. In addition to mixing people from different sectors with different levels of expertise, the panel received extensive briefings on the main characteristics of Asia and Europe, historic pandemics and infectious agents, WHO policies and pandemic preparedness.



The panel of stakeholders also drew on a set of Asian and European resource persons, a group of experts who lent their knowledge to the development of future scenarios. Their primary purpose was to provide technical assistance on matters where the panellists and the project needed further background information and insights, such as innovation, social networks and dynamics and climate change.

The list of resource persons of the ASEF-ASAP project can be found at the end of this document.

## ***2.3 Application of the ASEF-ASAP scenarios***

The three ASEF-ASAP scenarios describe different future pandemic contexts and pandemic preparedness. For each scenario, specific pandemics were identified and analysed for their potential impact and challenges. Dramatic events, developments, changes and discontinuities were analysed in terms of their impact on each scenario. Early-warning signals were also identified as pointers to predict in what direction scenarios may develop as we progress through our time horizon.

Actors from all the involved sectors looked at key actions that needed to be taken for each of the scenarios. By combining these actions across the scenarios and linking them with early-warning signals for each scenario, they identified elements in multi-sector strategies for genuinely comprehensive pandemic preparedness.

The identified driving forces, certainties (continuities) and uncertainties (discontinuities) and the different kinds of pandemic considered are set out in Chapter 3.

In the next steps of the project, the ASEF intends to reach out to society in Asia and Europe for actual implementation of these strategies.

# 3 Key contextual elements' impact on pandemic preparedness

This chapter explains the main building blocks of the scenarios developed in the ASEF-ASAP project. It explains and analyses driving forces and uncertainties for future pandemic preparedness in Asia and Europe, as well as the kind of pandemics and disruptive events or discontinuities that may have to be faced.

## ***3.1 Driving forces and continuities***

Many forces have a direct or indirect impact on the future of pandemics and pandemic preparedness, among them, political, economic, cultural, environmental, technological, financial or other forces. We can exercise a certain amount of control over some forces, but not over others. Contextual factors that are outside our control are of key importance in future pandemic preparedness.

In the ASEF-ASAP project, stakeholders identified 15 driving forces and looked into the type and level of associated certainties and uncertainties for the coming 30 years. For each driving force, a core uncertainty was defined. These are described in turn below.

## 1) *International regulation*

The international legal framework determines the rules of the game. In the field of public health the single most important legal instrument is the set of International Health Regulations (IHR), an international legal instrument that is binding for 194 countries across the globe, including all member states of WHO. They serve as the legal framework for the management of a pandemic. According to Article 2 of the IHR, their purpose is to “prevent, protect against, control, and provide a public health response to the international spread of disease”, while balancing the values of human rights and free trade.

The latest IHR (2005) reflect an important paradigm shift: (1) from reporting only three specified diseases (plague, cholera and yellow-fever) to reporting all public health events that are likely to spread internationally and affect travel and trade; (2) from passive reporting and pre-set measures to proactive surveillance and tailored response using real-time evidence for risk assessment and risk management; and (3) from control at borders to detection and containment at the source of the event.<sup>46</sup>

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<sup>46</sup> D., HEYMANN, C., CHU, et al. Capacity building under the International Health Regulations to address health emergencies of international concern. In: INSTITUTE OF MEDICINE (US) FORUM ON MICROBIAL THREATS, *Infectious disease movement in a borderless world: workshop summary*, Washington, National Academies Press, 2010, 195-204.

One positive spin-off of the IHR is that they require countries to strengthen their existing capacities for public health surveillance and response.

### **Certainties**

Since the scope of the IHR (2005) is very broad and cuts across a number of public health and other areas, the implementation of the Regulations at the national level is likely to foster more (health) regulations across many sectors and governmental levels.

In the absence of a global enforcement body in the field of public health, the temptation to free ride increases. Even though countries do not report or underreport the outbreaks of a disease because of other interests, they still benefit from the measures taken globally to provide a public health response.

### **Uncertainties**

The 2009-A/H1N1 flu was the first test of the effectiveness of the IHR. Overall, the IHR were used accurately and appropriately, as the WHO member states shared unprecedented levels of information. Nevertheless, there are still areas where nations may be withholding information or making unilateral decisions (such as imposing travel restrictions or failing to share virus samples) that do not support the language or spirit of the revised IHR. A case in point was the blockade on imports of pork from the USA and Mexico in 2009,

despite the fact there was no scientific evidence that swine flu could be transmitted by eating pork.<sup>47</sup>

However, resources to effectively ensure compliance with the IHR are still lacking. The regulations give WHO little authority to monitor and enforce rules and WHO has no authority to penalise a country that fails to report cases or violates a norm.

## Core uncertainty

International regulation  
*Compliance versus non-compliance*

## 2) *Political will and commitment*

The political will to seriously, measurably and sustainably address pandemic preparedness and response is a key factor in overall pandemic preparedness. Authorities at all levels need to be engaged and empowered to make pandemic preparedness and response work.

### Certainties

The 2009 A/H1N1 outbreak showed greater regional and international collaboration between political actors and bodies. At the same time, A/H1N1 demonstrated a politicisation of pandemics.

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<sup>47</sup> C., KRAUSS, A., MARTIN, Pork industry fights concerns over Swine Flu in *New York Times*, 28/4/2010.

It also showed how countries had difficulty complying with international health regulations.<sup>48</sup>

The availability of funds and the political will to allocate these to pandemic preparedness and response will to a considerable extent determine the effectiveness of the response.

### **Uncertainties**

The political agenda is drawn up in response to both internal motivations and external events. Internally, the political agenda is influenced by national issues and the national electorate. However, in an ever more connected and globalised world, it is increasingly difficult for individual countries to influence the international system. Therefore, external developments are important uncertainties.

Political uncertainties will also determine the future of the UN system, which in turn will influence international coordination of, and backing for, national pandemic preparedness and response.

Moreover, the availability of funds and the political will to allocate these to pandemic preparedness will to a considerable extent determine the effectiveness of the response.

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<sup>48</sup> K., WILSON, S., BROWNSTEIN, Strengthening the International Health Regulations: lessons from the H1N1 pandemic, *Health Policy and Planning*, Vol. 25, (2010), no. 6.

## Core uncertainty

Political will and possibilities  
*Uncommitted versus committed*

### 3) *Innovation, research and development*

The importance of technological advancement in pandemic preparedness cannot be underestimated. Innovation and research and development (R&D) not only make it possible to develop new techniques and methods to control existing infectious diseases, they may also make the development of new infectious diseases possible.

The United Nations World Health Organization (WHO) today endorsed a new rapid test for tuberculosis, which it says could revolutionise the way the disease is tackled by providing an accurate diagnosis in about 100 minutes, compared to current tests that can take up to three months.

*Source: New UN-backed rapid test could transform tuberculosis care and control, UN News Centre, 8 December 2010*

## Certainties

The traditional way to produce vaccines involves injecting live viruses into fertilised chicken eggs. This process is slow (the eggs



typically need to incubate for about six months), inefficient (on average, it takes one or two eggs to yield a single dose of vaccine) and unreliable. Innovation and R&D may make it possible for pharmaceutical companies to replace this method with more effective methods of developing vaccines and medicines.

Scientists are working on the development of genetically modified edible plants to produce vaccine antigens. They have already developed a potato that boosts immunity against hepatitis B, and are working on vaccine-producing peanuts.<sup>49</sup> Other techniques involve the development of DNA vaccines. The first trials of an H1N1 influenza DNA vaccine are already underway.<sup>50</sup> These new technologies will drive up the cost of the development of vaccines.

Automation in health care is expanding rapidly, particularly in Japan, where a strong history in robotics combined with a scarcity of human resources drive the development of machines to take over simple aspects of health care and even nursing.

## Uncertainties

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<sup>49</sup> S., TIWARI, P., VERMA, Plants as bioreactors for the production of vaccine antigens", *Biotechnology Advances*, Vol. 24, (2009), No.4.

<sup>50</sup> REUTERS, Inovio Pharmaceuticals, Inc. Immunizes First Subject In U.S. Influenza DNA Vaccine Clinical Trial, 15.06.2010 (1.12.2010, <http://www.reuters.com/finance/stocks/keyDevelopments?symbol=INO.A>).

A number of innovative vaccines are under development, but it remains uncertain if and when they can be put to broad use. Uncertainties over safety, the effectiveness of new techniques, the will to share knowledge and the cost of R&D will determine the use of innovative vaccines.

Vaccine production plays a key role in pandemic preparedness and response. Swedish researchers<sup>51</sup> found that, from an economic point of view, vaccinating at least 60% of the population in the case of an outbreak of an H1N1 influenza pandemic would reduce the cost of an epidemic to Swedish society by €250 million. The rapid development, production and distribution of pandemic influenza vaccines could thus potentially save millions of lives during an influenza pandemic.

However, the development of vaccines poses a serious challenge to vaccine manufacturers. Vaccine production involves high investment in R&D and in production facilities. It also requires significant know-how. Know-how is difficult to acquire and so technology transfer requires a strong cooperative relationship between a large number of partners.

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<sup>51</sup> L., BROUWERS, B., CAKICI, et al, Economic consequences to society of pandemic H1N1 influenza 2009 – preliminary results for Sweden, *Eurosurveillance*, Vol.14, (2009), No.37.

Vaccine production costs have a significant fixed cost component, representing up to 90% of total costs.<sup>52</sup> These costs include R&D, quality control and quality assurance, selling and distribution overheads and the construction and maintenance of production facilities. Moreover, one of the greatest obstacles to the development of vaccines is the cost and time necessary to shepherd a vaccine through the clinical research process to licensure and patenting.

In the event of a pandemic a few additional factors play a role. The sense of urgency is important and enormous pressure is placed on vaccine producers, from media, governments and the general public, to release a vaccine as soon as possible. The high cost per unit is not the only deterrent. Vaccine manufacturers are also discouraged to produce vaccines in response to a pandemic outbreak because of limited demand, liability concerns and price limits as a result of bulk purchasing.

Vaccine manufacturers recover high initial investment costs by selling their patented vaccines initially to governments via contracts and later to the general public. But, given the aforementioned

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<sup>52</sup> GLOBAL ALLIANCE FOR VACCINES AND IMMUNISATION, Key-concepts: Economics of vaccine production: understanding vaccine prices, s.d. (22.11.2010, World Health Organization, [http://www.who.int/immunization\\_financing/options/en/briefcase\\_vacproduction.pdf](http://www.who.int/immunization_financing/options/en/briefcase_vacproduction.pdf))

discouragements, it is uncertain whether R&D and innovation for the purpose of vaccine development can be sustainable.

The example of the production of vaccines highlights the key challenge of innovation and R&D in general: technological advancement is only sustainable if the benefits for investors outweigh the costs.

### **Core uncertainty**

**Innovation, research and development**  
*Sustainable versus unsustainable*

## **4) *Environment and ecology***

Whether our earth will be able to continue supporting life as we know it today depends on maintaining a delicate balance between the human desire to improve our lifestyle and wellbeing and preserving the natural resources and ecosystems on which we and future generations depend.

### **Certainties**

The scale of our current use of resources is such that future generations are unlikely to have access to a similar share of scarce resources. Humanity's ecological footprint has more than doubled since 1966. In 2007 (the most recent year for which data are available) humanity used the equivalent of 1.5 planets to support its activities. People are now using the natural environment's services

and resources 50% faster than the earth can renew them.<sup>53</sup> The consequences have been documented widely: loss of biodiversity, environmental pollution, global warming and an increasing frequency of natural disasters.

## Uncertainties

While the outlook is gloomy, change is possible. However, tough choices will have to be made in order for our societies to develop in a sustainable manner. Choices we make with regard to food and energy consumption, waste management and infrastructure represent immediate opportunities in relation to alternative energy sources, the availability of clean water and global biodiversity.

## Core uncertainty

**Environment and ecology**  
*Sustainable development versus resource abuse*

## 5) *Flows of people*

Throughout history, the movement of people has played a critical role in the transmission of infectious diseases. As a result of migration, trade, conquest, religion and war, disease germs have travelled from one environment to others. Ever more people travel ever longer distances to ever more diverse destinations today.

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<sup>53</sup> WORLD WILDLIFE FOUNDATION, *Living Planet Report 2010: biodiversity, biocapacity and development*, Gland, World Wildlife Foundation, 2010.

## Certainties

As the world globalises in terms of trade and investment, borders are opened up more easily to enhance the free flow of goods and services and, in their wake, people increasingly move from country to country. The UN estimates there are over 210 million international migrants in the world today.<sup>54</sup> In Europe, international migration is the main driver of EU population growth, resulting in a positive migration balance of 1 million people. Migrant labour will likely be part of the solution to Europe's future labour and skills shortages.<sup>55</sup> In Asia, the picture is more diverse. While India is projected to have a surplus of 44 million people of working age by 2020, China is likely to have a shortage of nearly 10 million.<sup>56,57</sup>

Asians and Europeans emigrate for a variety of complex reasons. Some are forced to move due to conflict, disasters or environmental

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<sup>54</sup> UNITED NATIONS, *Trends in Total Migrant Stock: The 2008 Revision*, New York, UN Department of Social and Economic Affairs, 2008.

<sup>55</sup> REFLECTION GROUP ON THE FUTURE OF EU 2030, *Project Europe 2030 Challenges and opportunities*, 01.05.2010 (08.06.2010, <http://www.reflectiongroup.eu/2010/05/08/project-europe-2030-challenges-and-opportunities>).

<sup>56</sup> GOLDMANN SACHS, *Ten things for India to achieve its 2050 potential*, 16.06.2008 (10.06.2008, <http://www2.goldmansachs.com/ideas/brics/ten-things-doc.pdf>).

<sup>57</sup> A., ROZENTHAL, *The global migration phenomenon*, s.d. (15.06.2010, Reflection group L-20 & IDRC, [www.l20.org/publications/41\\_gF\\_Briefing-Memorandum-Andres-Rozental.pdf](http://www.l20.org/publications/41_gF_Briefing-Memorandum-Andres-Rozental.pdf)).

change, while others voluntarily emigrate to study or to work in another country. Labour and trade migration is also likely to continue from rural to urban areas and will lead to the construction of megacities.

### **Uncertainties**

Immigration has positive as well as negative effects on both the sending and receiving countries. Immigrants add to the diversity of the receiving country's pool of talent and society. However, it is often associated with a large number of drawbacks such as human trafficking, illegal activities and brain-drain.

The prospect of large-scale forced migration as a result of climate change and other natural disasters remains subject to a large degree of uncertainty both in scope and nature.

Whether it will be possible to migrate freely in the future will depend on both the positive and negative effects of migration. The enforcement of international regulations on migrants will play an important role in this regard.

The global flow of people can take any shape in between these two extreme directions: freedom of movement of people may be limited or restricted ('lockdown') or people may be able to move freely across borders (such as today within the EU Schengen area).The possible spread of infectious diseases across boarders as a result of

migration could be a cause for restricting the freedom of movement of people.

## Core uncertainty

Flows of people  
*Lockdown versus worldwide free movement*

### 6) *Human interaction*

The way humans think and feel about their body in relation to others in society greatly influences whether and how diseases are being transmitted.

#### **Certainties**

People are becoming increasingly aware of their own health and personal hygiene. As people become more health conscious, their chances of living longer increase significantly. This will lead to population growth, especially in developing countries and in Asia. The UN population division predicts an increase in population and population density in large parts of the world in the next 50 years. In China, population density is projected to rise from 141 to 150 per km<sup>2</sup> by 2045. In Germany, on the other hand, population density is projected to decrease from 230 to 203 per km<sup>2</sup> by 2045.<sup>58</sup>

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<sup>58</sup> POPULATION DIVISION OF THE DEPARTMENT OF THE ECONOMIC AND SOCIAL AFFAIRS OF THE UNITED NATIONS SECRETARIAT, *World Population Prospects*:



## Uncertainties

The effect of a population increase in some countries and a decrease in others on how people feel about their body in relation to others in society is uncertain.

The evolution of social contact through IT-technology is likely to have a strong impact in this regard. New technological developments such as social media and mobile phones facilitate indirect contact but may also feed the desire of some for more community engagement, away from a virtual reality. While some may seek increased cultural exchange and direct contact with others, others may retreat physically into ever more interconnected societies. The uncertainty of how individuals will interact with one another in the future is an important driving factor in the transmissibility of disease and, as such, for the spread of a pandemic.

## Core uncertainty

**Human interaction**  
*Body protective versus tactile*

## 7) *Food demand*

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*The 2008 Revision*, New York, UN Department of Economic and Social Affairs, 2008.

Safe and reliable access to food is essential during a pandemic outbreak. According to the World Food Programme, food today travels an average of 1,600 kilometres.<sup>59</sup> If a pandemic develops and works its way around the world, one of the challenges will be maximising access to food as we contend with possible border closures and the inevitable transportation challenges.

### **Certainties**

The balance in food availability is the result of changes in both supply and demand. On the supply side, technological advancements are likely to make new, more efficient farming practices possible and increase the volume of produced food. Technological advances are also likely to improve the distribution of food.

### **Uncertainties**

Genetically modified food may offer an opportunity to secure the world food supply, but there are concerns over food safety and security with regard to changing farming practices. The fact that the world population is predicted to exceed nine billion by 2050 will further increase the demand for food and put more pressure on the availability of resources such as land and water for the production of food. In addition to increased demand for food from a rising

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<sup>59</sup> UNITED NATIONS WORLD FOOD PROGRAMME, *Safe, Reliable Access To Food Essential In Pandemic*, 28.04.2009 (4.12.2010, <http://www.wfp.org/stories/key-concern-safe-reliable-access-food>).

population, dietary shifts also have implications for world food demand. In Asia, for example, meat consumption is on the rise. The interplay of these factors will greatly influence whether or not there will be enough food for all.

## Core uncertainty

### Food demand

*Enough for all versus not enough for all*

## 8) *Health economics*

World Health Assembly Resolution 58.33 of 2005 explicitly mentions that people should be able to access health services and not be subject to financial hardship in doing so. In pursuing this objective, all stakeholders in the health system must make a continuous effort to improve the accessibility of health care services at an affordable price.

### Certainties

The economic conjuncture and the economic development of a country determine its ability to develop health services. Moreover, rising costs of R&D, increasing costs of insurance and the availability of generic medicines are likely to have an impact on the accessibility of health services.

### Uncertainties

Whether or not a country chooses to prioritise investments in the health system and to keep it accessible at an affordable price is, in the first place, dependent on the evolution of the global economic conjuncture, as this has an impact on the affordability of, and access to, drugs. Economic inequalities provide a climate for illegal activities. If people cannot access drugs, they will resort to the black market.

## Core uncertainty

**Health economics**  
*No priority versus priority*

### 9) *Health systems*

A good health system delivers quality services to all people, when and where they need them. A health system, which is the sum of the work of a large number of organisations, networks, services and resources, is the engine of the pandemic preparedness and response system.

#### **Certainties**

A quality health system requires a quality workforce and quality facilities. It requires logistics to deliver quality medicines, access to up-to-date technologies and a robust financing mechanism. There are differences between Asian and European countries in political approaches, institutional frameworks and health and social services. Yet they face similar challenges as they adjust to demographic

ageing, evolving technological opportunities (telemedicine and disease detection), changing individual preferences (private and home-based health care), increased demand for transparency and funding and human resource issues.

In developing countries, addressing these challenges will largely be limited to locating and earmarking the financial and human resources necessary for quality health care. In developed countries, access to health care will be a matter of keeping the current – often high quality – system affordable and attracting the human resources necessary to keep the system operational. Both the EU and Japan suffer from a shortage of medical professionals. In Japan the shortage of nurses is likely to rise to 550,000 by 2014.<sup>60</sup> In Europe, there will be an estimated shortage of 590,000 nurses, 230,000 doctors and 150,000 allied health professionals by 2020.<sup>61</sup>

## **Uncertainties**

The impact of technological developments in health systems could create a wide range of opportunities in both developing and developed countries. However, whether new techniques are safe and

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<sup>60</sup> AFP, APEC warned of critical labour shortages, 10.11.2009, (8.6.2010, Business Day, <http://www.businessday.com.au/business/world-business/apec-warned-of-critical-labour-shortages-20091110-i5om.html>).

<sup>61</sup> EUROPEAN FEDERATION OF NURSES ASSOCIATIONS, On the EU workforce for health, 12.05.2010 (10.06.2010, <http://www.efnweb.eu/version1/en/documents/EFNPressRelease-InternationalNursesDay-EPDeclarationonEUWorkforceforHealth-12052010.pdf>).

effective and whether developing countries have the possibility to use them remains uncertain.

## Core uncertainty

Health systems  
*Accessible versus inaccessible*

### 10) *Rights and ethics*

According to Article 25 of the Universal Declaration of Human Rights everyone has the right to a standard of living that is adequate for the health and wellbeing of themselves and their family. This covers food, clothing, housing, medical care, necessary social services and the right to security in the event of unemployment, sickness, disability, widowhood, old age or reasons beyond a person's control. In times of a pandemic it is important that such rights are safeguarded.

#### **Certainties**

In many Asian and European countries practice differs substantially from theory. Often, only privileged groups are able to effectively enjoy these basic human rights. It remains likely that, in the future, financial constraints and a lack of solidarity and social cohesion will deprive certain groups from being able to enjoy these rights and from accessing basic health care services and medication.

## Uncertainties

Whether these rights remain a privilege or become universal depends largely on the ability and willingness of all stakeholders to make health care available and accessible to everyone.

## Core uncertainty

**Rights and ethics**  
*Universal rights versus privilege*

### 11) *Zoonotic diseases*

WHO defines zoonoses as diseases and infections that are naturally transmitted between vertebrate animals and humans. At least 61% of all human pathogens are zoonotic and 75% of all emerging pathogens during the past decade were zoonotic, suggesting a growing trend.<sup>62</sup>

Interventions to control zoonoses require concerted action between the veterinary and human health sectors because these diseases affect both people and animals.

## Certainties

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<sup>62</sup> WORLD HEALTH ORGANISATION, The control of neglected zoonotic diseases, s.d. (05.12.2010, World Health Organization, [http://www.who.int/zoonoses/control\\_neglected\\_zoonoses/en/index.html](http://www.who.int/zoonoses/control_neglected_zoonoses/en/index.html)).

Animal disease reports are essential for tracking diseases. Each country differs in terms of disease reporting quality, irrespective of its level of economic development. The quality of reporting is influenced not only by the willingness of countries to report diseases but also by their ability to diagnose those diseases.<sup>63</sup> The dissemination of information through the mass media is an essential element in preventing and controlling zoonotic diseases, yet the media do not always pay sufficient attention to such diseases.

Continuing expansion of international travel and trade has also resulted in more international – legal and illegal – trade in animals and animal products. Moreover, as a result of climate change the migration pattern of animals is also changing.

### **Uncertainties**

In most countries there is no legal obligation to report animal diseases. Surveillance systems and national legislation for compulsory reporting of animal diseases could improve the quality of disease reporting. It remains uncertain whether countries are willing to report diseases, as the economic consequences in lost trade or tourism can be serious.

Ensuring safe food is paramount for the protection of human health. The role of animal feed in the production of safe food is also

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<sup>63</sup> WORLD HEALTH ORGANISATION, *Future Trends in Veterinary Public Health, WHO Technical Report Series*, (2002) No. 907.



recognised worldwide, as has been underlined by several recent events.<sup>64</sup> Cooperation between animal food and health agencies and human health food agencies is important in ensuring food safety.

Mitigation of the impact of animal diseases depends on whether integrated and effective prevention and control across the public and animal health domains are possible.<sup>65</sup>

## Core uncertainty

### Zoonotic diseases

*Integrated and effective control versus divergent control*

## 12) *Biological hazards and infections*

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<sup>64</sup> FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS, Veterinary Public Health and Feed and Food Safety (VPH), 29.12.2008 (28.11.2010, FAO, <http://www.fao.org/ag/againfo/programmes/en/a6.html>).

<sup>65</sup> The “One-World- One Health”, which was launched in 2004 by the Wildlife Conservation Society, envisages a comprehensive and holistic approach across the public and animal health domain to address high impact emerging infectious diseases. In 2008, FAO, WHO, OIE, World Bank and Unicef developed a strategic framework for reducing risks of infectious diseases at the animal-human-ecosystems interface.

A biological hazard, also known as a biohazard, is an organism or by-product of an organism that is harmful or potentially harmful to other living things, primarily human beings. Examples of biological hazards include infectious diseases, plant or animal contagion, insect or other animal plagues and infestations.

### **Certainties**

A biological hazard or infection can become harmful when it is either deliberately or accidentally released and is likely to take place as a result of an accident in an R&D laboratory, an error in biosecurity, biological warfare or environmental contamination in medicines.

### **Uncertainties**

There are many other factors of which we are less certain that could provoke a biological hazard or infectious disease, e.g., a disease from space, a new bug for which there is no vaccine or treatment or the impact of nuclear radiation on the mutation of a virus.

### **Core uncertainty**

**Biological hazards and infections**  
*Threat (intention) versus risk (accident)*

## **13) *Human mutation***

An organism's DNA affects how an organism looks and how it behaves, so a mutation in the form of a small change to an organism's DNA can cause dramatic changes to an organism.

Mutations can be beneficial, neutral or harmful for a human being.

### **Certainties**

A continuous improvement in knowledge of the DNA and gene structure of the human species makes it increasingly possible for mankind to alter the DNA structure of an organism, as illustrated by the modification of the genes of crops or the cloning of organisms. As our ability to modify DNA increases, the ethics of genetic modification will become increasingly important.

Human modification is not limited to DNA changes. Cybernetics, combining biology and technology, will start to play an increasingly important role in the near future, either by biological means, through nanotechnology or through a combination of both. A simple, current example of this is the pacemaker. A more complicated example is the connection of an artificial limb to the nerve system. Other cybernetic technical implants and augmentations are certain to follow in the next 30 years.

### **Uncertainties**

It is uncertain whether human mutation changes will take place safely and contribute to improving the species or will have catastrophic effects that may threaten the human species.

### **Core uncertainty**

## **14) *Early detection***

Early detection of epidemics is important because dealing with a disease in its early stages is easier and more economical than having to deal with it once it has become widespread. Given recent experiences of rapidly spreading global outbreaks of infectious diseases across borders and continents, an effective emerging-disease early-detection system would have to be global in scope and effort.

At present several global early-warning systems exist, such as the Global Early-Warning System for Major Animal Diseases including Zoonosis (GLEWS) and the Global Outbreak Alert and Response Network (GOARN).

Since 2000, WHO has worked hard on developing GOARN, gradually trying to strengthen its international network composition and operations and further develop GOARN specialist networks for risk reduction, readiness and intervention. The adoption of new IHR in 2005 helped to strengthen the system and its legal framework. The key challenges for WHO are ensuring truly global representation in the network, making greater use of partner capacities from neighbouring countries and promoting GOARN as an

operational partnership linked to specialist networks for response and targeted readiness.

The 2009 A/H1N1 flu was a test case for GOARN, but its impact was mixed. Support was provided by experienced GOARN partners and surge capacity was available; there was also close operational coordination and collaboration between regional offices and WHO headquarters. However, there were also a number of problems, with some experts in the field struggling to adjust to a new role and with the spread of the outbreak forcing WHO to bypass certain procedures.<sup>66</sup>

### **Certainties**

Technological developments such as new diagnostic tools, detectors of new disease subtypes and new communication tools are all likely to emerge in the future, making early detection more effective and efficient.

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<sup>66</sup> P., DRURY, Round Table 1 - The Added Value of the Networks in the Public Health: Best Practices and Lessons Learned, 23.04.2010 (06.12.2010, Episouth ,[www.episouth.org/outputs/presentations/Drury.pdf](http://www.episouth.org/outputs/presentations/Drury.pdf)).

Researchers have demonstrated fluorescent microscopy using a physical attachment to an ordinary cell-phone. The researchers behind the device say that it could identify and track diseases like tuberculosis and malaria in developing countries with limited access to health care.

The Cellscope, which came out of an optics-class project at the University of California, Berkeley, could capture and perform simple analyses of magnified images of blood and sputum samples, or transmit the images over the cell-phone network for analysis elsewhere.

Source: *A Cell-Phone Microscope for Disease Detection*, Anne-Marie Corley, [Technologyreview.com](http://Technologyreview.com), 23 July 2009

## **Uncertainties**

The success of a future globally integrated early-detection system will depend on global representation and effective partnerships across sectors and use of the latest available technology to make early detection possible.

## Core uncertainty

### Early detection

*Non-globally integrated versus globally integrated*

## 15) *Information and communication*

The A/H1N1 virus demonstrated the vital role of communication and information in pandemic preparedness and response. Transmitting correct information at the right time to the right audience is a critical challenge in times of a pandemic. As the world of information and communication is in a constant state of flux this will be a challenge for all actors involved and affected by a pandemic.

### **Certainties**

Within just ten years, global media consumption has exploded. The Internet, even more so than technological development, has changed the information and communication scenario dramatically. Whereas the Internet had about 50 million users in 1998, today it has an estimated 2 billion users.<sup>67</sup>

Moreover, the diversity of devices and locations to access the Internet has opened up a wide range of possibilities for both receiving and disseminating information globally. In particular, the

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<sup>67</sup> V., CERF, A decade of internet evolution, *The Internet Protocol Journal*, Vol. 11, (2008), No. 2.

dramatic increase in user-produced content on the Internet, uploaded in blogs, YouTube, Facebook, Twitter, etc. has profoundly changed people's exposure to information. Not only is there much more information available than ever before in history, digital technology has also enabled users to be more selective of their information intake. Users, via on-demand and pay-per-view systems, can decide themselves how and when they would like to receive information or communicate.

### **Uncertainties**

Being exposed to an overload of information through a variety of sources challenges the recipient, for whom it becomes increasingly difficult to decipher what information is credible and useful. The uncertainty of whether people will react indifferently, hysterically or critically on receiving news and information on their iPhones, PCs, Blackberries or local newspapers, TV stations and telephones is likely to strongly influence this driving force.

### **Core uncertainty**

**Information and communication**  
*Indifference versus critical reception*  
*versus hysteria*

#### *3.1.1. Overview of the 15 driving forces and their core uncertainties*

**International regulation**  
*Compliance versus non-compliance*



**Political will and possibilities**  
*Uncommitted versus committed*

**Innovation, research and development**  
*Sustainable versus unsustainable*

**Environment and ecology**  
*Sustainable development versus resource abuse*

**Flows of people**  
*Lockdown versus worldwide free movement*

**Human interaction**  
*Body protective versus tactile*

**Food demand**  
*Enough for all versus not enough for all*

**Health economics**  
*No priority versus priority*

**Health systems**  
*Accessible versus inaccessible*

**Rights and ethics**  
*Universal rights versus privilege*

**Zoonotic diseases**  
*Integrated and effective control versus divergent control*

**Biological hazards and infections**  
*Threat (intention) versus risk (accident)*

**Human mutation**  
*Safe adaptation versus catastrophes*

**Early detection**  
*Non-globally integrated versus globally integrated*

**Information and communication**  
*Indifference versus critical reception  
versus hysteria*

## ***3.2 Kinds of pandemic***

In the process of developing the ASAP scenarios, the stakeholder panel identified a series of potential diseases that may hit particularly hard in a particular scenario and others that may not be so challenging. Inspired by the process, the scenarios and research findings, the ASEF-ASAP project identified and worked with ten specific types of pandemic. Note that the term ‘infectious agent’ or ‘agent’ is broadly used to refer to the original aggressor causing the pandemic.

A wide and challenging spectrum of pandemics that might emerge in the future is described below. The approach taken in order to expand our current understanding of pandemics tries to reflect possible pandemics of the future – and not only those we are already familiar with. Imagination is a key element in this process and we understand that we may challenge the beliefs of some readers – as happened with some of the ASEF-ASAP panel members – but also believe that this is necessary if we want to truly prepare for what might happen.

### **Appearance of a new zoonotic agent**

Humans, domesticated animals and livestock live closely together in many parts of the world. Humans regularly encounter undiscovered living creatures as they explore new parts of the planet. Agents presently unknown to humans or new variants of agents have the

potential to pass from animals to humans (zoonosis) in a sustainable way.

### **Reappearance of an historical agent**

Agents that remained endemic in a small region or retreated for a period of time can resurface when conditions are favourable. They are known to experts but overall preparedness is absent because incidence and prevalence decreased over time (e.g., the cholera epidemic in Haiti in the post-earthquake period).

### **Mutation of an existing agent**

Well-known agents with a high frequency of gene mutation or reassortment of genetic material can colonise and infect human beings in new ways. Antibiotic resistance and antiviral resistance are good examples of how agents with newly acquired characteristics can become dangerous again to humans (e.g., multi-resistant bacteria). New zoonoses can also originate from mutations that enable agents to jump from animal habitats to human communities.

### **Highly transmissible (few deaths but much suffering)**

This kind of agent could cause serious damage in society in that a high percentage of the population will require extensive care even though overall mortality is low. This places an enormous burden on communities and especially on health care staff, as infected people recover slowly or when the damage remains permanent. Increasing numbers of a formally active population is lost to economic activity

while health care facilities stack up new cases (e.g., a highly transmissible Epstein-Barr virus causing mononucleosis and six months' inactivity for all infected people).

### **Undercover pandemic caused by new agent**

An undercover pandemic occurs when an agent with a long incubation period spreads widely before being detected. When the first symptoms in humans become apparent, the agent has already reached pandemic proportions with sharply decreased chances for containment and early response (e.g., the early years of AIDS or Creutzfeldt-Jacob disease, with an incubation period of up to 30 years but with very high mortality once symptoms become apparent).

### **Agent induced through genetic modification**

Crops or livestock which are genetically identical due to controlled gene modification are potentially vulnerable to new external aggressors. Opportunistic agents attacking such populations will cause serious damage as there is little or no basic immunity due to lack of gene diversity (e.g., a variant of foot-and-mouth disease could infect 50% of the genetically modified hooved livestock and acquire zoonosis potential). The agent itself could also be genetically modified, whether by accident or on purpose.

### **Cybernetic pandemic**

Medical devices and implants with external remote control functions

already exist today, e.g., pacemakers that can text an alarm message to the cardiologist in case of malfunction. Computer virus infection of these devices was proven possible in 2010.<sup>68</sup> The outlook of the ASEF-ASAP project stretches all the way to 2040, by which time other implanted devices will be connected to servers or networks for monitoring and automatic intervention. A cybernetic pandemic refers to a computer virus altering normal communications between a hub (server) and medical devices. Patients with implants affected by this malfunction would experience serious morbidity or even mortality. By definition, it can be considered as a pandemic with a broad vertical transmission potential.

### **Behavioural pandemic**

A peripherally related non-biological pandemic would be the sudden propagation of mentally transmitted ideas with negative health effects (with humans themselves as agents), such as collective suicide or depression spreading through a vulnerable population. In 2007, the *New England Journal of Medicine* published a study that proved a significant increase, over a 32-year period, in obese patients whose social network of family and friends showed a higher prevalence of obesity.<sup>69</sup>

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<sup>68</sup> R., CELLAN-JONES, First human 'infected with computer virus', 27.10.2010 (21.06.2010, BBC News, <http://www.bbc.co.uk/news/10158517>).

<sup>69</sup> N., CHRISTAKIS, J., FOWLER, The Spread of Obesity in a Large Social Network over 32 Years, *New England Journal of Medicine*, Vol. 357 (2007), 370-379.

### **Extra-terrestrial pandemic**

A variety of substances from space enters the atmosphere of our planet on a daily basis. Astro-biological scientific research, such as that conducted at the National Aeronautics and Space Administration (NASA) and European Space Agency (ESA), describes very complex molecules in extra-terrestrial matter that comes to earth in this way. Scientists from NASA recently identified a life form on earth that was built with arsenic.<sup>70</sup> The possibility of a pandemic caused by an extra-terrestrial substance thus cannot be ruled out.

### **Non-transmissible pandemic**

Serious diseases or conditions like obesity, Parkinson, Alzheimer, cancer, depression and hypertension can be considered as pandemics without the biological transmissibility factor. With globally increasing life expectancy, these pathologies will undoubtedly place a strain on society and health care budgets. The question remains, however, to what extent these conditions are behavioural.

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<sup>70</sup> NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, NASA-Funded Research Discovers Life Built With Toxic Chemical, 02.12.2010 (02.12.2010, [http://www.nasa.gov/topics/universe/features/astrobiology\\_toxic\\_chemical.html](http://www.nasa.gov/topics/universe/features/astrobiology_toxic_chemical.html)).

### ***3.3 Disruptive events and discontinuities***

Driving forces shape the future of pandemic preparedness, although we do not know to what extent or how. But the context for pandemics and pandemic preparedness can also very suddenly be changed by completely unforeseen events.

The 2010 Icelandic volcanic eruption, which grounded 100,000 flights and caused an estimated loss of more than 1.7 billion USD to the airline industry, is an example of a discontinuity. By definition, a discontinuity is an unpredicted break from an established pattern. In this case, the volcanic ash cloud disrupted the work and life of hundreds of thousands of people who rely on airplanes for their daily activities. In other words, discontinuities are events or even products that create a whole new reality.

The concept of discontinuities plays an important role in the scenario development process. By nature, the future is unknown, which makes it nearly impossible to anticipate discontinuities. By introducing discontinuities to the storyline of each of the scenarios, the ASEF-ASAP panellists could reflect on the impact, challenges and opportunities of a given discontinuity for their scenario.

The panellists identified possible disruptive events that could have a very strong impact on pandemics and pandemic preparedness up until 2040:

- 1) With information nodes concentrated in major cities around the world, a breakdown in global communication systems is feasible and would have disastrous consequences for coordinating a response to a pandemic.
- 2) The consequences of (global) nuclear conflict are difficult to estimate. Radiation affects people indiscriminately and supports mutation. If sufficiently widespread, it is likely to cripple the entire structure of society.
- 3) Climate change is also likely to start showing fairly unpredictable effects. Losses to inhabitable land due to a rise in sea-level, for instance, will have consequences for the economy of states affected and for migration.
- 4) A revolutionary technological breakthrough would also affect almost every scenario, e.g., in the fight against cancer there is scope for breakthroughs that could alter the demographic composition of our societies. The same applies to research into ageing itself.



# 4 Looking ahead: three scenarios for pandemic preparedness in Asia and Europe

## *4.1. Scenario logic*

The scenario logic of the ASEF-ASAP project places key uncertainties regarding future developments in the context of multi-sector pandemic preparedness in Asia and Europe. The key uncertainties selected by the multi-sector stakeholder panel describe political structures, the use of resources and prevalent economic interests. The scenario logic combines these key uncertainties in three distinct scenarios called Grey Paradise, MosaInc., and GloCal Blocs (Figure 3).

Figure 3: The scenario logic



As a story, each scenario illustrates how the driving forces and uncertainties described in Chapter 3 may unfold. Again, these are not stories describing visions or prophecies; rather, they describe what might happen and how the context for pandemic preparedness might develop. The important thing is that together, these three scenarios aim to describe the entire gamut of possible and relevant futures.

## ***4.2. The scenarios in a nutshell***

### **Grey Paradise**

In **Grey Paradise**, the development agenda in Asia and Europe is dominated by global political structures, redistributed resources and economic control by authorities. Step by step, continuing crises lead governments to increasingly put their faith in international regimes. This technocratic answer to financial, ecological and security challenges enables significant progress. Asian countries, fuelled by continued economic expansion, gain more power and increasingly dominate the international scene. Authoritarian governance becomes the global role model. Such global governance enables much progress in many areas but also evokes increasing dissatisfaction among large sectors of the population, leading to protests, apathy and new forms of disease.

### **MosaInc.**

In **MosaInc.**, developments in Asia and Europe are characterised by weak political structures, resources that are used as commodities and economic self-interest. In a series of economic, natural and human disasters and crises, political structures fail to provide an effective response. Budgetary room for manoeuvre gradually shrinks. People turn to self-organisation and civil society organisations and businesses take over services that are no longer provided by public institutions. The dispersion of power leads to a

mosaic of actors and structures, in which firms and corporations are the strongest players. Open and globalised markets and societal segregation are features of this innovation-rich future, challenged by many inequalities and security problems.

## **GloCal Blocs**

In **GloCal Blocs**, Asia and Europe are ruled by smaller regional or national political structures that use resources for their own development and to promote regional economic interests. The global drive for development leads to stiff competition for scarce (natural) resources between groups of states – the GloCal Blocs. Food becomes a new central element in this power struggle. Despite some collaboration between different blocs, conflict rises and erupts.

# 5 Grey Paradise

## 5.1. *Storyline*

### *Forced and unpretentious moves to global responses*

In the second decade of the 21<sup>st</sup> century, Asia and Europe are starting to become used to global crises. The financial crisis that started in 2008 continues to have strong repercussions; in Europe, national governments face the need to save the Euro, under considerable pressure since the first waves of instability in 2010 and 2011. EU leaders are gradually being forced to go further with the Europeanisation of financial policies in order to avoid breakdown and to safeguard economic development.

Meanwhile, the economic and political influence of Asia continues to rise and, with it, the interest of Asian governments in creating a stable international financial architecture. The continued pressure from financial markets makes it obvious that European solutions alone will not be sufficient and that Asian governments need to take on more responsibility. Slowly and reluctantly, Asia and Europe lead the world to a new global financial system.

The on-going financial crisis is not the only problem. Environmental degradation is taking a high toll. Galloping industrialisation in Asia

is placing a serious burden on the region's health systems. Air quality in China, for instance, is now a major problem. Across Asia and Europe, extreme weather events fostered by climate change haunt societies: droughts, floods, massive snowfalls, heatwaves, etc. Increasingly, these problems lead to economic upheaval. Affected transport logistics are hitting the globalised economy at a sensitive point. Environmental migration increases pressures further. Security problems loom. Even if reluctantly and only pushed by crises, governments worldwide increasingly accept international coordination at the expense of national sovereignty.

It is the Asian states, however, which are decisively pushing for a more global approach to tackling crises. Economic turmoil has weakened the position of the USA and Europe. China, India and the ASEAN nations are not prepared to simply transfer power to UN bodies. Their doubts about the effectiveness of UN organisations come paired with a strong will to maintain their influence and room to manoeuvre. This provides an impetus to creating new international regimes with tight control over power under the umbrella of the G20 or occasionally in separately coordinated moves. Together with the existing UN bodies, this results in a complex setting of international bodies and governance structures.

No bold steps are taken at once. No great plans are developed. The move towards new forms of international governance is made carefully, step by step, unpretentiously and without much ado. The

process shows results and enables newer forms of tighter cooperation that spill over into other policy areas. For the EU and its member states, the process seems familiar, reminiscent in some ways of the slow post-World War II integration process. Indeed, the EU's experience with creating supranational structures with technocratic decision-making is a useful source of expertise, and also its long established lead in pushing environmental issues globally. Yet the longer-term consequences of this incremental process come as a surprise to the Europeans who continue to believe that they are in the driver's seat; in reality, however, the car is a taxi that Asia is coming to steer independently.

#### *Success through technocratic authority*

The technocratic approach is revealed in the world's capacity to deal with some of its problems. Over time, financial markets stabilise. Environmental degradation in Asia is slowing down and in some cases is even reversed. The tighter grip on international coordination leads to solutions to some of the world's longest-standing conflicts, such as in the Middle East. Sea routes become safer, with pirates facing concerted and merciless action. African countries stabilise and their markets open up. The result of international governance plays strongly into the hands of some Asian countries, with China in the lead and India following closely behind. Their economic credit is translated into decision-making power.

Asian world leadership provides different solutions to many of the world's problems. Nuclear energy becomes the dominant source of energy. With rising Asian technology solutions for energy, the use of fossil fuels comes under tough international regulation. In order to cater for world food demand, international regimes agree on large-scale changes in agricultural production. As a result, in 2024 the world witnesses a record boom in industrial farming. The genetically modified (GM) crop industry is booming, with new, faster growing GM crops and animals. Farming communities become more sensitive to zoonosis. Europeans strongly protest the wide use of GM technologies, but Europe is no longer in a position to block agreements and their implementation. The continuing effects of climate change remind the world of the need for concerted action in a globalised world.

Governments and governmentally controlled companies and agencies become strongly involved in R&D and assume the associated risks. Scientific research, R&D and innovation shift from the private to the public domain. Key developments include the end of the traditional patent system in favour of patent pooling, open-source innovation and global technology transfer to less developed regions. R&D is largely confined to universities, with production left to the private sector. Given the importance of health for the global system, the international regimes establish global and emergency health care systems. This goes hand in hand with basic education initiatives and new requirements for health education and training in



behavioural change, leading to more equal and basic access to health care. There is a push towards preventive medicine. Meanwhile, private health care systems continue to exist. The improvements in health care and education lead initially to population growth and, eventually, to better control over major communicable diseases and decreased fertility rates in developing countries.

With these remarkable achievements, countries and governments outside Asia and Europe look increasingly to Asia for inspiration and reference. Western and European models provide “20th century recipes”, states the 2027 declaration of the Organisation of African States, while “Asia provides the contemporary role models for development”. Tightly controlled authoritarian political regimes with large degrees of economic freedom are symptomatic of an approach that is spearheaded by Asian countries and seen across the world as the most effective path towards broad progress in society. Also in the rest of Asia, this type of government is becoming the rule rather than the exception.

### *Challenges for a world under tight international control*

Asia-dominated global governance is not without side effects. With large-scale development across Asia, cities become overcrowded. The green-city approaches and attempts to develop peripheral areas by the political leadership prove unable to change this dynamic.

Much of Europe's top talent finds better conditions and more interesting challenges in the booming cities of Asia than in stagnating Europe. The relocation of the headquarters of a number of European multinationals to Asia (Nokia, Siemens, HSBC etc.) leads to large-scale protests in Europe. Tourism has become Europe's major industry. Meanwhile, climate change thwarts world food production and the development and use of GM organisms is further accelerated.

With basic health services available to many and other basic needs catered for, average life expectancy now exceeds 90. The proportion of the elderly in societies has risen strongly. So has the number of elderly suffering from dementia. Having so many unproductive old people poses massive problems. Euthanasia becomes legalised and is applied widely. "Is obesity our new plague?" is a question asked by the main electronic news media in their headlines. Disenchantment with the tightly controlled way of life grows among people. Many flee from what they call 'grey paradise' into virtual worlds where free space is abundant. Among youth, there are striking cases of social-media-coordinated group suicides, or 'flash-mob self-euthanasia' as it is called in the public electronic wills of those engaging in the practice.

Meanwhile, the global governance system suffers from increasingly byzantine bureaucratic structures. More and more frequently, mistakes are made and covered up. Discontentment rises. Business

people complain behind closed doors about the inefficiency of the governmental systems. Other parts of societies wonder more and more openly if the way chosen really is the right one. By 2035, 'Individual Freedom Day', launched as a virtual event by computer hackers in the Philippines in the mid-2020s, has developed a massive following across Asia, Europe and the rest of the world. Groups of minorities call for autonomy and independence. Autarchic groupings try to disconnect from cities in their attempt to flee the grip of authorities. New religious groups that mushroomed throughout the 2020s and 2030s start heated debates over the need or not to stop experiments with human cloning and genetic manipulation. As 2040 approaches, Grey Paradise is in a shaky situation.

## 5.2 Uncertainties in Grey Paradise

Uncertainty	Grey Paradise
<p><b>International regulation</b></p> <p><i>Compliance versus non-compliance</i></p>	<p>Compliant</p>
<p><b>Political will and possibilities</b></p> <p><i>Uncommitted versus committed</i></p>	<p>Committed, but some countries more than others, also in terms of ideologies</p>
<p><b>Innovation, research and development</b></p> <p><i>Sustainable versus unsustainable</i></p>	<p>Sustainable for the bottom of the pyramid (cheap, egalitarian, preventive), difficulties for the upper part of the pyramid</p>
<p><b>Environment and ecology</b></p> <p><i>Sustainable development versus resource abuse</i></p>	<p>Redistributed resources and sustainable development, yet accompanied by resource abuse where development is given political priority</p>
<p><b>Flows of people</b></p> <p><i>Lockdown versus worldwide free movement</i></p>	<p>Largely free flows, yet may be stirred by authorities</p>

<p><b>Human interaction</b></p> <p><i>Body protective versus tactile</i></p>	Tactile and problems seem to get solved
<p><b>Food demand</b></p> <p><i>Enough for all versus not enough for all</i></p>	Largely enough for all
<p><b>Health economics</b></p> <p><i>No priority versus priority</i></p>	Medium priority, in a perspective of low prices for services, yet coverage is key not money
<p><b>Health systems</b></p> <p><i>Accessible versus non-accessible</i></p>	Accessible
<p><b>Rights and ethics</b></p> <p><i>Universal rights versus privilege</i></p>	Universal right to basic and partially advanced health care
<p><b>Zoonotic diseases</b></p> <p><i>Integrated and effective control versus divergent control</i></p>	Effective control but early detection does not guarantee a solution
<p><b>Biological hazards and infections</b></p> <p><i>Threat (intention) versus risk</i></p>	Threat, intentional hazards probable due to strict and far-reaching authoritative approach that brings counter-

<i>(accident)</i>	reactions
<b>Human mutation</b> <i>Safe adaptation versus catastrophes</i>	By and large, safe adaptation as focus is generally not on this subject
<b>Early detection</b> <i>Non-globally integrated versus globally integrated</i>	Globally integrated early detection system
<b>Information and communication</b> <i>Indifference versus critical reception versus hysteria</i>	Indifference and little interest, as problems seem to get solved

### 5.3. Pandemics in Grey Paradise

- **Appearance of a new zoonotic agent**

The conformity to large-scale industrial farming results in a vulnerability to zoonosis. Although Grey Paradise has an operational surveillance system for pandemics, it could fail in its early stages due to a lack of reporting and rapid follow-up. Later on, there is a

significant risk of unwillingness to report among resistant population groups and individuals who do not accept constant surveillance by the authorities. People may also be hesitant to report their own disease as registration may have unwanted repercussions.

- **Reappearance of an historical agent**

There is especially a risk of STDs emerging as a new pandemic. People in general will be reluctant to report from their private spheres as they have so few places left that are largely free of state monitoring and surveillance.

- **Mutation of an existing agent**

Because access to basic health care is almost universal, mutations with new characteristics such as antibiotic resistance are very possible. Multi-drug resistance may become a particular problem in Grey Paradise as innovation is more geared towards incremental improvements at the bottom of the pyramid and less towards expensive, revolutionary treatments. Super-bugs are a very real threat in Grey Paradise.

- **Highly transmissible agent (few deaths but much suffering)**

Grey Paradise assumes a coordinated response, specifically to conventional threats. The capacity to manage a surge in demand on health care facilities and workers is more present than in the other scenarios in contrast a disease with low mortality and high

transmissibility may easily reach pandemic proportions if infections are not very visible or distinguishable and hence are difficult to pick up by the surveillance system.

- **Undercover pandemic caused by new agent**

This is not a high risk due to the existence of a global surveillance system. However, if the new agent is a non-standard or entirely new type of agent, there is the chance that it will slip through the system.

- **Agent induced through genetic modification**

This is a high risk in Grey Paradise. Food is produced on an industrial scale. Animals and plants lack the genetic diversity that would protect them against opportunistic agents. The monitoring and response system is vulnerable to covered-up individual mistakes, malicious intent, sabotage and bio-terrorism. If this kind of a pandemic develops in Grey Paradise, it may disrupt the food supply for years.

- **Cybernetic pandemic**

The uniformity of state-controlled networks provides opportunities for external interventions. Computer viruses that remotely affect medical systems are probable and could be caused by a revolt of hackers against government lifestyle interference. At the same time, in Grey Paradise, specialist bio-electronics used in humans will be less advanced than in other scenarios, thwarting cybernetic attacks



of pandemic proportions.

- **Behavioural pandemic**

The tightly government-controlled Grey Paradise is highly susceptible to these underground and largely intangible phenomena. Copy-cattng, through electronically supported formations across the physical world, could lead to an increase in depression, euthanasia and suicide in societies worldwide.

- **Extra-terrestrial pandemic**

If the extra-terrestrial infectious agent is hitherto unknown, as is likely, it will catch Grey Paradise, which is generally well-prepared, but not for the unknown, unawares.

- **Non-transmissible pandemic**

The increased life expectancy and general basic welfare of the population in Grey Paradise increases the risk for diseases such as obesity, cancer, depression, Parkinson and others.

## ***5.4 Effects of discontinuities***

### *Communication system breakdown*

The authorities and the elaborate pandemic surveillance and response systems in Grey Paradise are highly dependent on elaborate communication systems. A breakdown in the global

communication system is one of the Achilles' heels of the authorities in Grey Paradise. Controlling society becomes more difficult. Confidence in the effectiveness of the political system that is central to its legitimacy would be undermined. The level of vulnerability to pandemics shoots up.

### *Nuclear conflict*

In Grey Paradise, a nuclear conflict as such is not highly likely. More likely are nuclear accidents or politically or religiously motivated acts of terrorism. In such cases, health resources would be consumed by the response and the governance system would be shaken. The vulnerability to pandemics rises.

### *Major inhabitable space change due to environmental changes (e.g. sea-level rise)*

Grey Paradise allows strong political action. Yet the system would be challenged by the consequences of massive migration, resulting from environmental changes. If the change occurred slowly, then the response systems could be adapted. If the change occurred quickly, a tendency to inflexible reactions to the unexpected and a false sense of security could have devastating effects and open the doors to pandemics.

### *Technological breakthroughs (e.g. universal vaccine, "wonder drug")*

In Grey Paradise, technological breakthroughs, such as the development of a universal vaccine or wonder drugs, look less probable because of the focus on basic health services. On the other hand, a broadly applicable anti-disease vaccine makes sense as the object of public research and development. If such a vaccine or drug became available, it would further enhance life expectancy and may, indeed, lead to a faster future destabilisation of Grey Paradise.

### ***5.5 Early-warning signs***

Signs showing Asia and Europe on the way to Grey Paradise are first and foremost the centralisation of power in international technocratic structures. More subtly, the way to Grey Paradise could reveal itself in a global downsizing of military capacity. Also, in progress towards a Grey Paradise, governments pooling their procedures would lead to increased global tendering.

# 6 MosaInc.

## **6.1. Storyline**

### *The erosion of trust in government*

In the aftermath of the economic crisis of 2008-2009, the world runs into even more serious economic trouble. Building on an erosion of trust in the Eurozone and in its ability to function properly, a second economic crisis hits Europe and the USA. This second crisis surpasses the first one in severity. People in Europe start to lose their trust in banks and in the stock market. This leads to calls for strong, decisive measures by the EU. The price of gold rises. Asia is not as badly affected as Europe, although it is affected by the loss of purchasing power in the USA and Europe.

The economic crisis is not the only kind of crisis. Natural disasters seem to have become more frequent in the early 21<sup>st</sup> century. Partially fuelled by climate change and climate variability, they increasingly affect Europe and Asia. Throughout the decennium, floods, earthquakes, volcano eruptions, heat waves and droughts further accelerate the depletion of natural resources. Food production and food security are affected and prices rise sharply. This situation, in turn, fuels covert and open conflicts in Asia, the

Middle East and Africa. In 2015, a nuclear accident in China leads to a massive loss of life which, in turn, leads to a noticeable drop in economic wellbeing throughout Europe and Asia.

People in Europe and Asia first call on their governments and on the EU to take decisive measures to counter the effects of the crises. The EU, however, finds it more and more difficult to reach agreement. With sharply rising costs, more EU member states run into serious financial trouble. The more affluent EU member states do not want to bail their neighbours out again and again. Calls for re-nationalising many policies become more urgent. Effectively, the EU becomes a two-tier system, with the economically weaker countries in the second tier forming a much more loose affiliation. The same happens in the ASEAN region, whose influence wanes across the continent. In the EU, citizens lose interest in the supranational construction of the EU and voter turnout for European Parliament elections drops to a mere 15%.

People in Asia and Europe look to their national governments for solutions. Many national governments attempt to follow their own separate ways in addressing problems. But where are the means? National budgets in Asia and Europe have been sharply reduced by the on-going financial crises and heavily burdened by natural and man-made disasters. Government administrations are overburdened. Citizens in Asia and Europe begin to realise that not just international institutions, but public authorities in general, are

failing to solve their problems. Governments scramble for the respect and trust of their own citizens. The state has lost much of its financial muscle, governing power and legitimacy.

The series of disasters and the failure of governments to deal with them lead to a profound shift in priorities. Spurred on by the dire economic situation, economic growth and wealth creation become the overall priority. Individual action becomes key in recovering lost wealth. The market loses its strains. Social protection in the developed countries of Europe and Asia is reduced to minimum levels. State funds for development assistance to poor countries are cut sharply. Funding for international regional bodies and UN agencies is withdrawn or sharply cut. Collective action, solidarity and support to the poor increasingly depend on voluntary engagement and gifts.

*A profit-driven world increasingly dominated by private companies and cultural groupings*

The failure of governments and international institutions in Asia and Europe creates a void and public services, including health, are reduced across the board. Citizens turn to private companies, who seem to offer the security that governments are no longer able to provide. Specifically, large international companies understand the opportunities provided by these crises. Their engagement is welcomed and in many cases even demanded by citizens who call

for jobs, products and services. In 2021, the bulk of existing health care systems within Europe has shifted towards private health care initiatives. Asia moves even further towards private health care. The commodification of health care services and goods – along with other public services – creates new market opportunities. Health companies stock vaccines and antivirals on behalf of multinational corporations and update the stockpile. This leads to greater disparities between the poor and rich populations.

Private companies and enterprises demand more rights and more exceptions from existing rules and regulations. Companies make use of the fact they are the ones that generate capital and employment. They become less and less bound by environmental, tax and labour legislation. This increases the risk of environmental exploitation, ecological abuse and inequalities, and also increases opportunities for innovation and economic development.

Governments and regional bodies in Asia and Europe continue to lose influence. Their initial attempts to take more national-protective measures are countered by the rising power of corporations who fight for easy market access. Governments are puppets in a game that they no longer control. This development is fuelled by the economic success of corporations. Many corporations in Asia are particularly active in providing services to large numbers of people (including the less affluent), fully exploiting economies of scale and the laws of large numbers. Mergers and alliances lead to globalised

businesses and fierce competition, yet hardly any national ties. Corporations take over global governance.

Profit pushes R&D and innovation, which is now market-driven and not necessarily need-driven. SamSAP, resulting from a merger between Samsung and SAP, develops comprehensive e-health packages for individuals as an essential tool in global health systems. Moreover, starting in Japan e-doctors and medical robots increasingly replace health workers. Common diagnoses become a part of home-based health care.

Intellectual property is not effectively protected by states or international organisations, so copying is an easy way to create business. Companies are forced to release new products as quickly as possible on a large scale to make as much profit as possible before the idea is copied by others. Corporations therefore become more secretive and set up security divisions to protect their secrets from espionage. Because of the pressure to bring products onto the market, safety risks increase. Reacting to these problems, corporations agree to set up a global patent and copyright regime through a shared company.

Media and communication play an important role in societies. Personal and corporate communication is strongly interest-driven and supports a world of highly mobile people. Moving and travelling long distances and living in several places has become part of the



normal life of many people – poor, rich and the many shades in between. It is a highly mobile world, in which differences between individuals are very important. Many cultural and lifestyle groupings develop in both the real world and in virtual environments. Within them, people feel at home and united; outside them, distance and protection are key. Bad news – real or imagined – travels quickly.

As a counter-development to the increasingly profit-driven and individualist society, many people turn to religious congregations or newly developed social groupings. These groupings increasingly replace the cohesive forces of nationality at turn of the millennium. They also provide protection and specific services and thus form a competition of sorts to corporations.

*Strong disparities and a growing need for common approaches*

Overall, the focus on markets and the stronger role of companies results in remarkable economic success. Asia and Europe regain lost wealth and flourish. At the same time, new challenges arise. Asia and Europe are faced with growing inner differences. More and bigger megacities emerge, and the disparity between urbanised and remote areas grows. Despite more effective food production due to industrialisation and distribution by corporations (up to 30% by 2030-2040), the problem of world food supply is not resolved entirely. The share of alternative sources of energy continues to increase, but the burden of the energy sector on the environment is still heavy.

These disparities add to the gap between the rich and the poor and the many shades in between. National boundaries have lost much of their importance. Many countries have split up - not even the larger countries of Asia could avoid this. Poorer areas in Asia and Europe are increasingly left to their own devices. Some start to develop alternative ways of living, often with old or new religious or social approaches. Many such areas, however, become a fertile breeding ground for crime and corruption. This also affects richer areas, which experience smuggling of goods and people, theft and robbery. This is an opportunity for organised crime to influence companies and what is left of governments. Illegal powers start to run certain areas. In some areas of Asia and Europe, conflict escalates and leads to violent clashes, sometimes involving the remnants of military forces.

Companies in Asia and Europe have already taken over many formerly public services, but growing problems add a new dimension to the challenge. Companies develop more extensive care and security systems for their clientele and employees. They increasingly take over a social role in society, teaming up with and supporting cultural groupings. The pressure to tackle imbalances on all fronts leads to broad calls for more coordinated, common approaches. Large companies, cultural groupings and the few remaining governmental structures create collaborative agreements as a new form of societal regulation to tackle problems.

Implementation remains a problem. Towards the end of the 2030s, many wonder to what extent these can tackle the growing unrest in Asia and Europe.

## 6.2 Uncertainties in Mosalnc.

Uncertainty	Mosalnc.
<p><b>International regulation</b></p> <p><i>Compliance versus non-compliance</i></p>	<p>Largely non-compliant due to weak states, with private companies and others creating own systems</p>
<p><b>Political will and possibilities</b></p> <p><i>Uncommitted versus committed</i></p>	<p>Overall uncommitted and heavily weakened by series of crises that lead to fundamental loss of trust in government, with political power shifts to companies</p>
<p><b>Innovation, research and development</b></p> <p><i>Sustainable versus unsustainable</i></p>	<p>Sustainable and very profitable, yet needs own protection by companies as states too weak to protect international patents effectively</p>
<p><b>Environment and ecology</b></p> <p><i>Sustainable development versus resource abuse</i></p>	<p>Resources as commodities, with resource abuse next to sustainable development regulated by market forces and societal groups</p>
<p><b>Flows of people</b></p> <p><i>Lockdown versus worldwide free movement</i></p>	<p>Largely worldwide free flows between countries, yet possible lockdowns (guarded areas, no-go zones, etc.)</p>
<p><b>Human interaction</b></p> <p><i>Body protective versus tactile</i></p>	<p>Body protective, yet tactile among specific communities, from the well-protected to religious and other groups</p>

<p><b>Food demand</b></p> <p><i>Enough for all versus not enough for all</i></p>	<p>Enough for all who can afford it and those who cannot depend on innovations (e.g., synthetic foods or other)</p>
<p><b>Health economics</b></p> <p><i>No priority versus priority</i></p>	<p>High priority in market-driven societies, lower priority among societal communities</p>
<p><b>Health systems</b></p> <p><i>Accessible versus non-accessible</i></p>	<p>Accessibility depends on means or belonging to special societal-religious groups and so is very compartmentalised</p>
<p><b>Rights and ethics</b></p> <p><i>Universal rights versus privilege</i></p>	<p>Privilege, either by being able to afford it or by belonging to specific societal group</p>
<p><b>Zoonotic diseases</b></p> <p><i>Integrated and effective control versus divergent control</i></p>	<p>Divergent</p>
<p><b>Biological hazards and infections</b></p> <p><i>Threat (intention) versus risk (accident)</i></p>	<p>Risk of accidents high due to poor regulation and intensive innovation</p>
<p><b>Human mutation</b></p> <p><i>Safe adaptation versus catastrophes</i></p>	<p>High probability of catastrophes due to poor regulation and intensive innovation</p>

<p style="text-align: center;"><b>Early detection</b></p> <p style="text-align: center;"><i>Non-globally integrated versus globally integrated</i></p>	<p>Not integrated across the board, with the possibility that companies provide services and with competition likely</p>
<p style="text-align: center;"><b>Information and communication</b></p> <p style="text-align: center;"><i>Indifference versus critical reception versus hysteria</i></p>	<p>Very mixed picture with all three elements, but hysteria may result from the lack of authoritative information</p>

### 6.3. Pandemics in Mosalnc.

- **Appearance of a new zoonotic agent**

Mosalnc. is characterised by great and complex economic differences. In the poorer areas and among the poorer populations, raising different kinds of livestock and crops close to home is a way of providing food. This mixed animal/human lifestyle combined with poor health conditions is a potential reservoir for zoonotic pandemics among the poorer elements of populations. Early containment is circumstanced, as it focuses on protecting cities and the more affluent members of society. Furthermore, Mosalnc. relies on highly extensive food production using agro-industrial innovations on a large scale, with a far more reduced focus on safety measures against microbial contamination.

- **Reappearance of an historical agent**

The problem of continuous re-emergence of opportunistic agents is plausible, especially in areas with poor living conditions in MosaInc., e.g., typhoid, diphtheria, cholera, whooping cough, hepatitis and STDs. In MosaInc. megacities, infectious agents may resurface and become endemic in poor areas and slums. A largely privatised health sector might lead to increase use of antibiotics and to higher chances of multi-drug resistance. With natural resources becoming very scarce and valuable in MosaInc., corporations search for metals and minerals in areas previously hardly or not at all touched by humans in deep waters and underground. Workers could come across hidden sleeping agents that turn out to be sustainable in human habitats (stoonosis).

- **Mutation of an existing agent**

Production in MosaInc. tends to be advanced and innovative but less secure, enhancing the risk of mutating existing agents.

- **Highly transmissible agent (few deaths but much suffering)**

Asia and Europe in MosaInc. may find it specifically difficult to deal with a long-term disruptive pandemic, as it would greatly affect markets and the functioning of economies. The absence of governmental or large authoritative bodies may make Asia and Europe specifically unprepared to deal with such a challenge.

- **Undercover pandemic caused by new agent**

The highly mobile world of Mosalnc. fosters contact between people in and between Europa and Asia. Early-warning, prevention and monitoring systems for disease are privately organised and more accessible to the socioeconomically prosperous layers of society. An undercover disease could infiltrate and prosper in slums before it takes hold.

- **Agent induced through genetic modification**

The risk of a genetic modification is considerable in Mosalnc. due to more innovative yet less secure R&D and production. The resulting infectious agent could flourish along with new genetically modified organisms (GMOs) or be a GMO itself. Flourishing nanotechnology might also support the pandemic.

- **Cybernetic pandemic**

Networked medical robots, medical devices and implants are widely used in Mosalnc. All these devices are vulnerable to cybernetic attacks. The great dependence on technology in Mosalnc. places Asia and Europe at risk of cybernetic pandemics. The more advanced devices are affordable only to the more affluent, which entails the possibility of an upper-class pandemic threat in Mosalnc.

- **Behavioural pandemic**

Mosalnc., with its strongly fragmented societal groups, is a breeding ground for sects, although it seems less plausible that harmful behavioural memes may develop to pandemic proportions.



Hysterical reactions by diverse groups to news are, however, one of the common traits of Mosalnc. Even if below pandemic proportions, challenging group behaviour with negative health implications can be a serious risk for Asia and Europe in Mosalnc.

- **Extra-terrestrial pandemic**

Asia and Europe in Mosalnc. are more at risk from an extra-terrestrial pandemic as there is no globally integrated early-warning system to warn against this threat. However, the focus on R&D in Mosalnc. may deliver new treatments faster and quicker than in the other scenarios.

- **Non-transmissible pandemic**

Mosalnc. is featured by both diseases and conditions linked to poor living conditions and to increased affluence with nutrition transition.

## ***6.4. Effects of discontinuities***

*Communication system breakdown: Disastrous consequences in Mosalnc.*

The breakdown in communication would hit Mosalnc. very hard, especially corporations and the private sector. Communication is key in this highly globalised and differentiated world and its breakdown could bring panic and soaring crime. It would push

MosaInc. towards a large-scale economic crisis. Due to the importance of communications for cities, these may be more affected than rural areas. Transportation and logistics systems, key for bringing treatment to people in the event of a pandemic, would be strongly affected and the impact of a communication breakdown during a pandemic would be devastating. The later this happened in MosaInc., the more likely it may lead to serious security problems and even widespread armed conflict.

*Nuclear conflict: short-term shock, longer-term destabilisation*

In MosaInc., a nuclear conflict seems less plausible on a global scale but more plausible on a restricted, regional scale. Its effects in terms of a massive death toll, radiation illness, decreased food supply would transmit a serious shock to the system. Some corporations may go bankrupt and change in the global market power balance is highly plausible. In the short term, the nuclear conflict leads to mass migration of people to unaffected areas and may increase the tendency in MosaInc. for people to focus on the individual or group situation. In the longer run, this drastic event may lead to a complete destabilisation of the system and a resurfacing of governmental or other communal approaches and structures, specifically if the nuclear conflict is not controlled.

*Major inhabitable space change due to environmental change (e.g. sea-level rise)*

In Mosalnc. the problems of food supply and security combined with massive immigration would hit poorer areas and poorer populations particularly hard.

*Technological breakthroughs (e.g. universal vaccine, "wonder drug")*

Due strong investments in R&D, there is a strong drive towards breakthrough innovations in Mosalnc. While a wonder drug would be of initial benefit, although mostly for the richer populations, a trickle-down effect in societies makes technological advances available to all. Pandemic preparedness would greatly benefit from this kind of breakthrough in Mosalnc.

## ***6.5 Early-warning signals***

A development towards a Mosalnc. scenario would be evident in the ongoing failure of governments to deal with the large-scale challenges and crises ahead. Due to this failure, we would see many governments toppling, including those of larger countries. We would also see a great deal of privatisation and a strong move to control by the private sector.

# 7 GloCal Blocs

## 7.1 Storyline

*Scarcity and competition lead to GloCal Blocs*

Asia and Europe are part of a global drive towards more wealth. Asia in particular makes impressive progress in developing its economic power, boasting strong and even double-digit growth in many countries. The financial crises have taken their toll but some voices in Asia speak of 'Western financial crises'. With new industrial capacity and sharply rising domestic and international demand, countries in Asia and Europe often find themselves on opposite sides of a battle for natural resources and scarce materials. Responding to the rising demand for food and for more advanced food products becomes a key concern and a central element of power in Asia. The situation is becoming increasingly competitive. China's strength becomes more and more visible. Japan and Europe have to fight to stay ahead in many areas of advanced technology.

Faced with such fierce competition, governments in the EU move closer together. Many countries in Asia do the same through supranational regional bodies. Grouped countries feel that, if they combine their natural and economic resources, they have greater leverage and can benefit from technological dependence.

Governments within these blocs find their own answers to balancing economic, environmental and developing needs. In Europe, environmental concerns are high on the agenda. In Asia, the situation is quite diverse, with many countries clearly putting development first. Despite its ageing population, the EU is blocking immigration from Northern Africa in response to popular pressure. While the EU is debating whether or not to open its borders more to immigrants with higher education, Asian blocs are busy doing just that: attracting and selecting immigrants who can support regional and economic development.

The competition between blocs is accelerated by technological progress, R&D and innovation. Advances in the health sciences are boosted by emerging diseases that bring about advantageous budget allocations. An increasing number of countries rely on nuclear energy as a transitional source of power because of the effects of climate change and the depletion of natural resources. Much investment is being made in generation IV nuclear energy in an attempt to achieve subcritical levels of radioactive waste. There is much R&D competition between the regions, but also selective cooperation where there is a clear advantage for both sides. This form of cooperation and competition is widely called 'cooptition', which is selected as expression of the year 2019 by the Asia-Europe Linguistic Society, winning by a narrow margin over its closest rival, 'glocal', which reflects the local approach to global problems that is dominant in Asia and Europe.

### *GloCal Blocs wealth and tensions*

Cooptition between GloCal Blocs fuels development and prosperity, particularly in many Asian countries. Industrialisation has led to more than 70% of the Asian and European population moving to urban areas. Growing environmental problems contribute to increased alienation of people from nature in many blocs in Asia, but also in European societies. Quality of life is one of the stated aims of all layers of society and all the countries, which is responded to by readily available consumer goods.

But there are still some differences between the Asian countries and blocs. Some blocs focus on economic development, whereas others target broader cooperation. Faced with ever stiffer global competition, the EU is taking decisive steps to further integrate into a United States of Europe.

Adequate basic health care is a key element in the competitiveness of blocs. In many of the more successful blocs, state-provided basic health care is accessible by everybody. Highly specialised services are only available to the elite through a private health care system. As a result of continuous developments in R&D, medical treatment of more exotic disorders becomes possible through genetic mapping. Evidence-based traditional medicine from within the distinct cultures of the respective blocs is on the rise.

Together with technological developments, the economic shift in balance between Asia and Europe leads to new divides. Some developed Asian blocs and Europe attempt to leapfrog through highly specialised R&D and services with largely automated industrial production. In the developing Asian blocs, industrialisation based on cheap labour drives growth. A class of professionals in Europe and the rich Asian blocs contrasts with a class of increasingly skilled workers in developing Asian blocs.

In Europe and Asia, cooptition has also created new challenges to cultural identity, which in turn affect how immigration is treated within the blocs. In European countries such as the United Kingdom, there is talk of a 'migrant-dominated society'. In 2025, a South Asian migrants party gains 15 seats in the European Parliament. In Asia the concept of trade is increasingly linked to the identity of nations and blocs. Often, migrants from outside the block are perceived as weakening this identity. Many migrants in Asia live in separate pockets in cities with a distinctive culture of their own. The same holds for many parts of Europe. People inside these pockets are often marginalized, poorly integrated in society and lack the health services available to the rest of society.

*Tensions turn violent*

The problem of scarce resources in Asia and Europe is not easing. In terms of food, Asians have turned increasingly to consuming meat. In Asia, GM food is widely used to respond to increasing demand. Contract farming has largely replaced traditional agricultural practices in Asia. Obese Asian passengers needing to buy two seats on Air Asia no longer make the headlines.

For a long time, Europe held off modernisation of food production, focusing more on its own production of organic food and compensating the lower yield with increased food imports. This approach, however, comes under pressure from tougher competition for food resources. As the effects of climate change begin to manifest themselves, water is increasingly seen as a scarce and valuable resource. Iceland creates a lucrative business by exporting water to the United Arab Emirates.

As a result of changes in diet and food production technologies, immune systems weaken and people become more vulnerable to germs. Diabetes becomes a major problem. Sugar and fat replacements show long-term negative effects. One headline reads: "Continued use of stevia causes osteoporosis." Health research reaches new frontiers. Genetic mapping opens the way for genetic treatment of the foetus. This in turn leads to new forms of discrimination, such as regarding the perceived superiority or inferiority of genes. Some blocs start to experiment with using this knowledge to gain a competitive edge. Casualties result.



Competition reaches a new height.

In the 2020s, technological advancement and mixed farming turn Africa, Brazil, parts of Mongolia and Greenland, and some areas of Russia into major food producers. They are also important sources of scarce metals and minerals – key elements in advanced industrial production. Lagging behind in development, Africa becomes the battle arena for these resources. Blocs of Asia, the EU and the USA engage in an increasingly violent and open struggle for Africa's resources. Violent African terrorism increases.

Critical reports on this topic can be read in media in some blocs, depending on the bloc's openness and freedom of expression. However, the public mood is focused on the home turf and other blocs have moved away in mental perception. Along the same lines, many media have developed a strong block bias. Social media and social networking follow this trend, despite the existence of fringe groups with a global outreach. More violence between the blocs looms.

## 7.2 Uncertainties in GloCal Blocs

Uncertainty	GloCal Blocs
<p><b>International regulation</b></p> <p><i>Compliance versus non-compliance</i></p>	<p>Patchy international regulation and compliance, blocs enter bilateral regulation, varying and situational degrees of compliance</p>
<p><b>Political will and possibilities</b></p> <p><i>Uncommitted versus committed</i></p>	<p>Varying degrees of commitment, blocs mainly committed within their own bloc</p>
<p><b>Innovation, research and development</b></p> <p><i>Sustainable versus unsustainable</i></p>	<p>Unsustainable on world scale and, within the blocs, more sustainable or unsustainable depending on bloc</p>
<p><b>Environment and ecology</b></p> <p><i>Sustainable development versus resource abuse</i></p>	<p>Resources for own development is the focus, with resource abuse in large parts of the world and Asia, with other parts of Asia and Europe more sustainable</p>
<p><b>Flows of people</b></p> <p><i>Lockdown versus worldwide free movement</i></p>	<p>Lockdown between many blocs, selected movement between other blocs</p>
<p><b>Human interaction</b></p> <p><i>Body protective versus tactile</i></p>	<p>Tendency to tactility in many blocs, and to body protective in other blocs</p>

<p><b>Food demand</b></p> <p><i>Enough for all versus not enough for all</i></p>	<p>Enough for all in some blocs, other blocs will fight with the not-enough-for-all situation</p>
<p><b>Health economics</b></p> <p><i>No priority versus priority</i></p>	<p>Low priority in some blocs, high(er) priority in leading blocs</p>
<p><b>Health systems</b></p> <p><i>Accessible versus non-accessible</i></p>	<p>Mostly accessible for basic treatments in many blocs, but not in all blocs</p>
<p><b>Rights and ethics</b></p> <p><i>Universal rights versus privilege</i></p>	<p>Highly dependent on bloc, although the concept of universal is under pressure on the world scale, and right becomes linked to belonging</p>
<p><b>Zoonotic diseases</b></p> <p><i>Integrated and effective control versus divergent control</i></p>	<p>Divergent due to a lack of control over the food chain</p> <p>Further implementation of agroindustries and worldwide consequences for ecotourism</p>
<p><b>Biological hazards and infections</b></p> <p><i>Threat (intention) versus risk (accident)</i></p>	<p>Variations depending on blocs</p>
<p><b>Human mutation</b></p> <p><i>Safe adaptation versus catastrophes</i></p>	<p>Higher probability of catastrophes due to competitive situation between blocs</p>

<p style="text-align: center;"><b>Early detection</b></p> <p style="text-align: center;"><i>Non-globally integrated versus globally integrated</i></p>	<p>Non-integrated, strong difference between blocs</p>
<p style="text-align: center;"><b>Information and communication</b></p> <p style="text-align: center;"><i>Indifference versus critical reception versus hysteria</i></p>	<p>Very mixed picture varying between hysteria and critical reception, with indifference less probable due to more tense global situation</p>

### ***7.3 Pandemics in GloCal Blocs***

- **Appearance of a new zoonotic agent**

In GloCal Blocs, zoonosis is strongly linked to mutated agents because of mixed farming activities in major parts of the world and the potential unwillingness of blocs, so as not to endanger their economic and competitive situation, to communicate the existence of a new agent spreading within animal and/or human communities.

- **Reappearance of an historical agent**

Although every GloCal Bloc could have its local infectious agents, the risk of global spreading is more limited due to limits on migration. Human immunodeficiency virus (HIV), tuberculosis, malaria, diphtheria, dengue, etc., could regain momentum, especially in combination with acquired antimicrobial resistance.

- **Mutation of an existing agent**

GloCal Blocs incorporate a risk of mutation, such as in the form of a superflu, as a result of a reassortment of the genes that originate from different influenza strains circulating within the mixed 'megafarms' of one particular bloc.

- **Highly transmissible agent (few deaths but much suffering)**

Even if the agent is capable of spreading throughout the globe, it probably will not reach official pandemic status. Global responses are difficult between the blocs and this may create a problem, especially for the more vulnerable blocs.

- **Undercover pandemic caused by new agent**

The economic and strategic interest in not reporting cases fuels the possibilities of an undercover agent. Cover-ups are very plausible in this scenario and could have devastating consequences, not just in the bloc of origin, but also when other blocs are affected but the agent remains undetected. If an undercover infectious agent becomes global in GloCal Blocs, Asia and Europe will both suffer.

- **Agent induced through genetic modification**

In GloCal Blocs, the loss of biodiversity due to GM food production could lead to a much more vulnerable society. The immunoprotective power of normal (human and animal) gut flora is not yet fully understood, but changes in this reservoir due to GM

nutrition transition could have a negative effect on immune systems (assumption). Science has already demonstrated a link between human gut flora and the prevalence of obesity. The focus on gene technology in the GloCal Blocs makes this kind of pandemic a significant threat, especially if used for covert biological warfare or terrorism.

- **Cybernetic pandemic**

The drive for innovation will increase the number of implants in the human population (therapeutic) and livestock (monitoring), which could entail the potential for an information-dissemination epidemic, contained by bloc. Preparedness for this kind of pandemic could deprive more traditional threats such as dengue, malaria, etc. of resources.

- **Behavioural pandemic**

Behavioural pandemics seem less relevant in the GloCal Blocs scenario, although the tendency towards secrecy and information wars between blocs may lead to hysteria in some populations.

- **Extra-terrestrial pandemic**

Asia and Europe in the GloCal Blocs scenario seem more at risk from an extra-terrestrial pandemic as there is no globally integrated early-warning system and few means to develop a rapid, global response. Depending on the kind of threat it poses, this kind of pandemic may, however, lead to more global cooperation.

- **Non-transmissible pandemic**

Obesity, diabetes and cardiovascular conditions become serious societal problems in GloCal Blocs across most of Asia and Europe.

## ***7.4 Effects of discontinuities***

### *Communication system breakdown*

A breakdown in communication systems in GloCal Blocs would strongly affect response systems within the blocs and make them more vulnerable to pandemic threats. In fact, the breakdown may well result, directly or indirectly, from the partially violent tensions between the blocs. The economies in GloCal Blocs are technology-intensive, which adds to the vulnerability.

On the other hand, the fact that the blocs are distinct and not necessarily open to each other may make a disease less likely to spread and a communication breakdown may well lead to a halt in the spread of the disease.

### *Nuclear conflict*

In GloCal Blocs a nuclear conflict is more likely to happen between blocs and is less likely to occur on a global scale. Pandemic preparedness would certainly be affected in the blocs concerned, as

it would not be a priority for the health system. In non-affected blocs, the mass suffering caused may trigger solidarity reactions and provide an impetus to a more global approach or lead to even stronger dissension.

*Major inhabitable space change due to environmental changes (e.g. sea-level rise)*

This discontinuity and the migration that follows could challenge the lines between GloCal Blocs. It would certainly put lots of pressure on the system. In terms of possible pandemics, it opens up new hazards, as the GloCal Blocs seem not ready for a cross-bloc or global approach needed to cope with this challenge.

*Technological breakthroughs (e.g. sea-level rise, "wonder drug")*

In GloCal Blocs, a technological breakthrough such as a universal vaccine risks being caught in the tensions and conflict between blocs. The implementation of intellectual property is not a given in other blocs, which increases the risk of conflict. Moreover, poorer blocs or excluded countries may not be able or willing to pay. GloCal Blocs also creates more difficulties regarding the development of such a breakthrough, as the exchange of scientific findings is tempered by competitive considerations. If it appears nevertheless, it will raise the stakes in GloCal Blocs even further.



## ***7.5 Early-warning signals***

Asia and Europe on the way to a GloCal Bloc future would witness a particular combination of signals. Bloc-building and greater development of supranational entities (such as the EU) is one of these signals. This signal needs to occur in combination, however, with a breakdown in international agreements. Additionally, the increase in conflicts over intellectual property rights between countries and regions points very specifically to the formation of GloCal Blocs.

# 8 Dynamic strategies for pandemic preparedness in Asia and Europe

Grey Paradise, Mosalnc., and GloCal Blocs describe three very different contexts for pandemic preparedness. In order to be prepared for future pandemics, it does not suffice to take account of one scenario merely, let alone to choose one. Multiple sectors in Asia and Europe have to be prepared for all three scenarios in order to respond adequately to future pandemic threats.

The scenarios form the basis for concrete strategy development in pandemic preparedness. ASEF will start the development of strategies for pandemic preparedness with a series of workshops for multiple sectors in Asia and Europe. Participants from civil society organisations, the private sector and governmental institutions across both regions will gather to develop strategies for their organisations, sectors, societies, and for Asia and Europe at large, based on the three different scenarios presented in this report.

ASEF hopes that its own series of strategy development

workshops will give impetus to the development of pandemic preparedness strategies by multiple sectors and organisations across Asia and Europe. ASEF calls on all to make use of the scenarios to develop their multi-sector pandemic preparedness.

The three scenarios, strategies developed in the workshops, documentation, multimedia applications and links to facilitation services for the discussion of the scenarios and the development of strategies will be accessible via ASEF's website at: [www.asef.org](http://www.asef.org).

Only with the engagement and active participation of citizens, NGOs, the private sector and public authorities across Asia and Europe can adequate and successful pandemic preparedness become a reality. We invite you to join in!

# The Asia-Europe Foundation

The Asia-Europe Foundation (ASEF) promotes greater mutual understanding between Asia and Europe through intellectual, cultural and people-to-people exchanges. Through ASEF, civil society concerns are included as a vital component of deliberations of the Asia-Europe Meeting (ASEM<sup>71</sup>). ASEF was established in February 1997 by the participating governments of ASEM and has since implemented over 500 projects, engaging over 15,000 direct participants as well as reaching out to a much wider audience in Asia and Europe. [www.asef.org](http://www.asef.org)

The ASEF Public Health Network is a unique participatory platform which encourages public health dialogue in Asia and Europe. The

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<sup>71</sup> ASEM now brings together 46 member states (Australia, Austria, Belgium, Brunei Darussalam, Bulgaria, Cambodia, China, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Indonesia, India, Ireland, Italy, Japan, Korea, Laos, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mongolia, Myanmar, the Netherlands, New Zealand, Pakistan, the Philippines, Poland, Portugal, Romania, Russia, Singapore, Slovakia, Slovenia, Spain, Sweden, Thailand, United Kingdom, Vietnam) plus the European Commission and the ASEAN Secretariat. [www.aseminfoboard.org](http://www.aseminfoboard.org)

Network provides space for an array of actors from health and non-health sectors to share their knowledge and experience. This exchange helps in facilitating partnerships between multi-level stakeholders including representatives of governments, international organisations, business corporations and non-profit organisations.

Cooperation between Asia and Europe to deal with infectious diseases and prepare to tackle pandemics has been strengthened through the Network. Projects engage young people and specific vulnerable groups, such as migrants and sexual and ethnic minority groups, through creative and participatory formats.

Communicating with people to improve awareness on public health issues is also a core activity of the Network.

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# The ASEF-ASAP panel

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## Infectious disease terminology

The **prevalence** of a disease is defined as the total number of cases of the disease in the population at a given time, or the total number of cases in the population divided by the number of individuals in the population.

The **incidence** of a disease is defined as the number of new cases of the disease in the population within a specified period of time, preferably as a proportion of the total number of cases during that same period of time.

The **mortality rate** of a specific disease is a measure of the number of deaths in a population directly related to that disease, scaled to the size of that population, within a specified period of time. The mortality rate is typically expressed in number of deaths per 1000 individuals per year.

**Morbidity** refers to a medical condition, disability, or poor health in general due to a well-defined cause. The term refers to the presence of disease or to the degree that the condition affects the patient. Co-morbidity is the simultaneous presence of two or more medical conditions.

**Virulence** refers to the disease-producing capacity of an infectious agent. High virulence is related to higher mortality and morbidity.

**Transmissibility** is the capacity of an infectious agent to pass from one host to another so that the disease is spread over a wider population of hosts.

**Horizontal transmission** is the transmission of the agent between hosts of the same species that are not in a parent-child relationship.

**Vertical transmission**, also known as **mother-to-child transmission**, is the transmission of an infectious agent from mother to child during pregnancy, during labour or immediately after birth.

**Case-fatality rate:** The percentage of persons diagnosed as having a specified disease who die as a result of that illness within a given period.

G., L., MANDELL, J., B., BENNETT, R. DOHLIN et al. *Principles and practices of infectious diseases (7<sup>th</sup> edition)*, London, Churchill Livingstone, 2009.

