Prevention and Control of Emerging Infections

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Infectious Disease Practice and Innovations

The Medical City

Prevention and Control of Emerging Infections

- Background
- Drivers of emergence and spread
- Snapshots of recent epidemics: lessons on prevention/control
- Challenges

Are We Making Progress to Eliminate Infectious Microbes?

Antimicrobials

- **Control symptoms**
- **Destroy organisms**
- **Eradicate diseases**

We've prematurely claimed victory before …

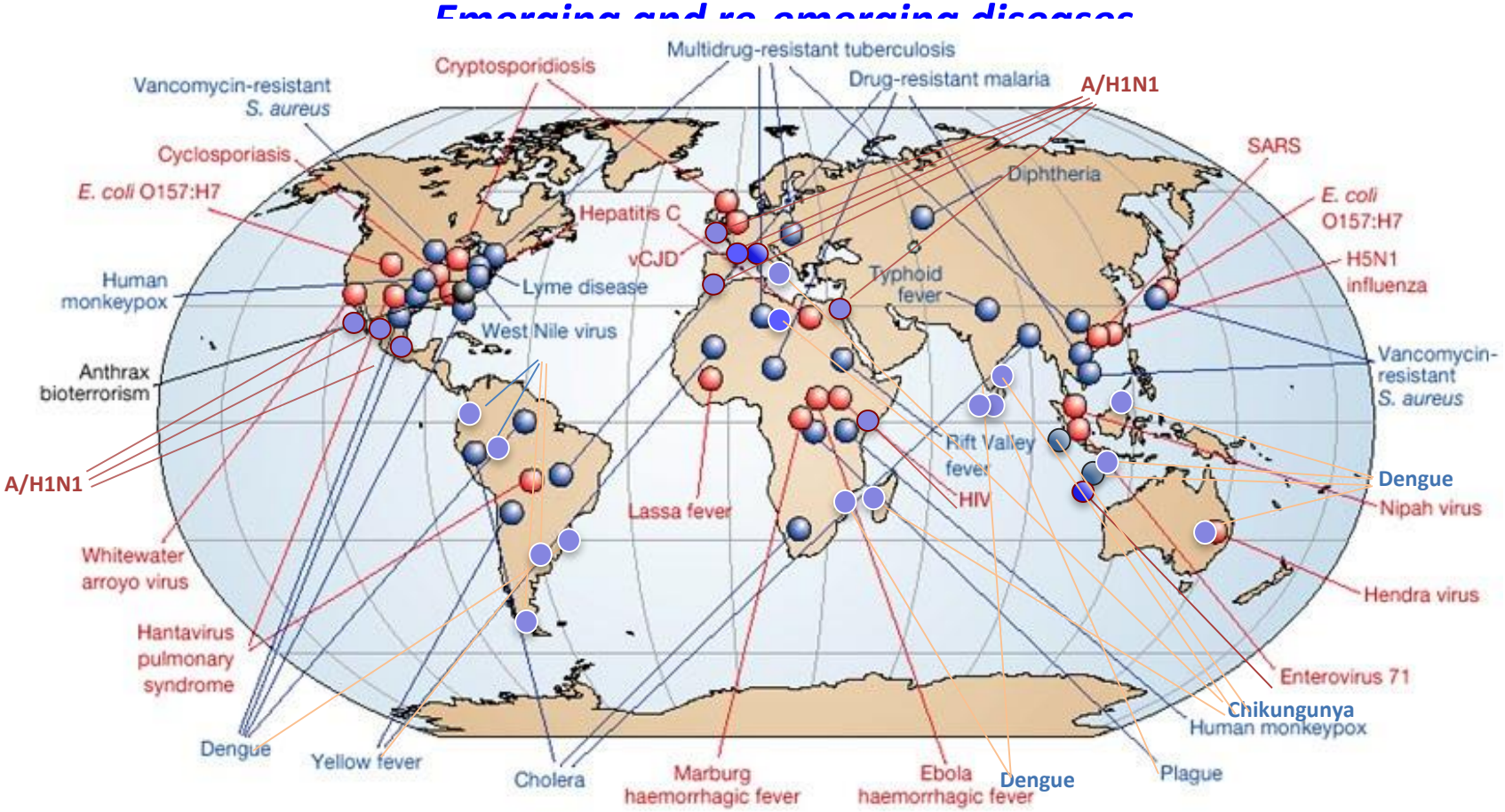
"It's time to close the book on infectious diseases, declare the war against pestilence won, and shift national resources to such chronic problems as cancer and heart disease."

– Surgeon General William H. Stewart

1967

Sources: World Health Organization. WHO Report on Global Surveillance of Epidemic-prone Infectious Disease. Geneva: WHO, 2003.
Emerging Crisis in Infectious Diseases: Challenges for the 21st Century. The Pfizer Journal. 2004;5:2.

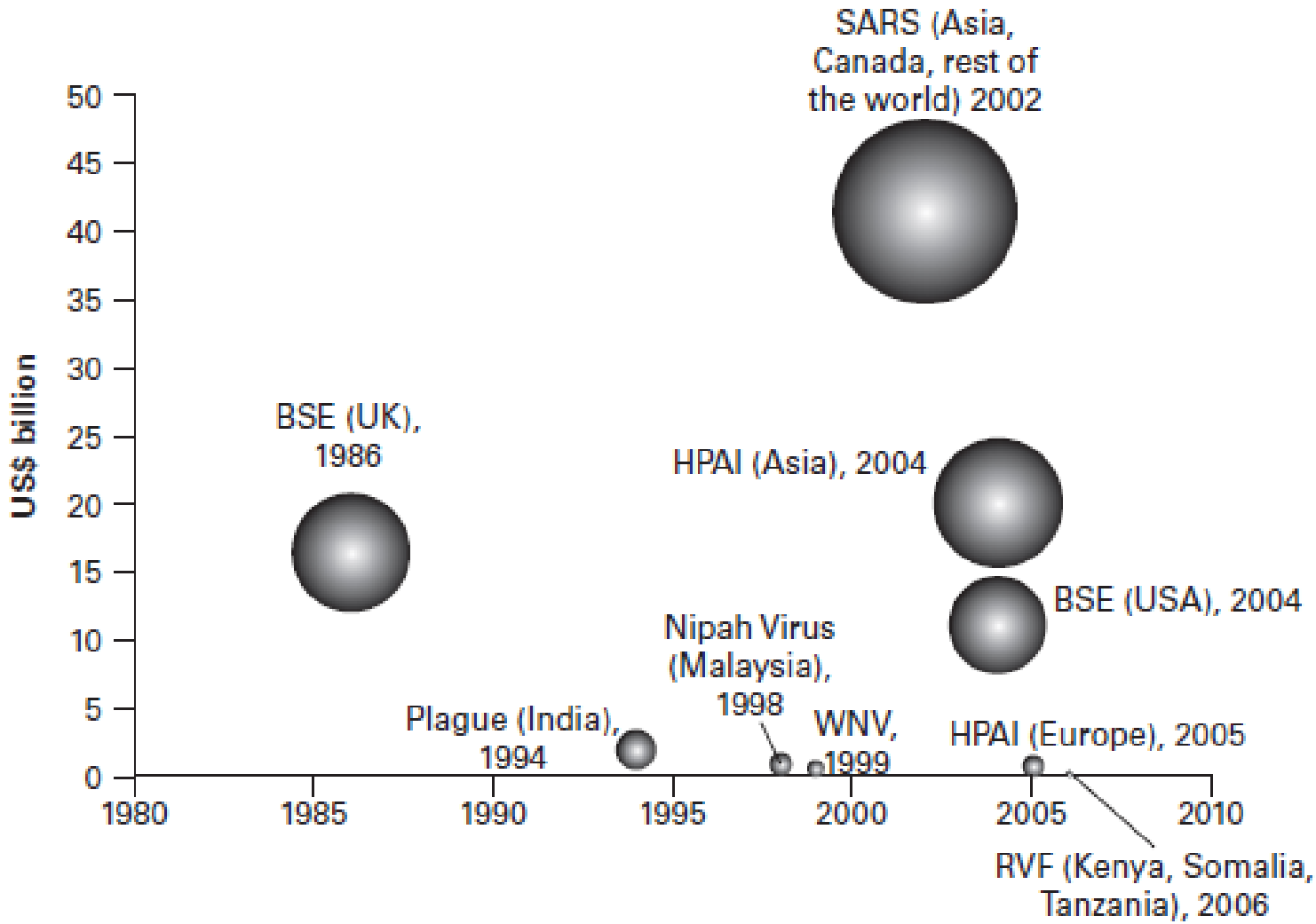
The Global Threat of Infectious Diseases



WHAT do they have in common?

- **Majority (60%) caused by zoonotic pathogens**
  - 72% originated in wildlife
- **Vector-borne diseases 23%**
- **Many originated from Asia**
- **Problematic diagnoses and treatment**
- **Correlated w/ socio-economic, environmental and ecological factors**
- **Major economic impact**

Estimated cost of emerging zoonotic infections (1986-2006)



Estimated cost of emerging zoonotic infections (1986-2006)

- **A World Bank study in 2012 estimated that the economic losses from six major outbreaks (Nipah virus, West Nile fever, SARS, highly pathogenic avian influenza, BSE and Rift Valley fever) of highly fatal zoonoses between 1997 and 2009 amounted to at least US$80 billion.**
- **If these outbreaks had been prevented, the benefits of the avoided losses would have averaged $6.7 billion per year.**
- **Fortunately none of these outbreaks developed into a pandemic**

Pandemics are a prime global catastrophic threat

- **Severe influenza pandemic**
- **~ 71 M human fatalities**
- **Potential losses $ 3 trillion (4.8% global GDP)**

Prevention is better than cure for emerging infectious diseases

Emerging infectious diseases have the potential to cause considerable morbidity, mortality, and economic damage. **David Heymann** and **Osman Dar** explain why we need to shift the emphasis from responding to emerging infections once detected to preventing them from occurring in the first place

Emerging infectious diseases (emerging infections) have caused tens of billions of dollars' worth of damage in the past 20 years and the costs are continuing to rise.[1 2] Emerging infections can be new infections, such as HIV (when first discovered), which is thought to have emerged in human populations from a non-human primate; or existing infections that are becoming more common or spreading in geographically new areas as a result of changes in the micro-organisms or changing climate and include West Nile fever, Dengue fever, and chikungunya.[3]

Many people assume that emerging infections are a matter for tropical disease specialists, but they are important to doctors and policy makers, vets, farmers, traders, and economies globally. Although some emerging infections are specific to tropical areas, such as Ebola and Marburg haemorrhagic fevers, infections that emerge there can spread to other parts of the world, as seen with HIV. There are also many examples of diseases originating in non-tropical settings, including severe acute respiratory syndrome (SARS), influenza A (H5N1), variant Creutzfeldt-Jakob disease/bovine spongiform encephalopathy (BSE), and foodborne *Escherichia coli* O157 infections.[4 5] Another problem is infections that have emerged in new forms—for example, multidrug resistant staphylococcal and mycobacterial species.

Over the past decades there has been increasing recognition that the way we deal with infectious disease is often reactive and too late. New diseases are often identified only after they have transferred to humans and sometimes many years after the breach in the species barrier.[6] In this article we describe how doctors and other professions are beginning to work together to stop emerging infections earlier.

How do infectious diseases emerge?

A review of emerging infectious diseases in the past 60 years suggests that just under two thirds were transmitted from animals, with just over 70% of these from wild animals and the rest from domesticated animals.[1] For example, a recent emerging infection, Middle East respiratory syndrome coronavirus (MERS-CoV), which was first reported in 2012, may be associated with dromedary camels.[7] Globalisation and foreign travel have resulted in new convergences of people, animals, and the environment and have altered ecosystems, providing some microbes with the opportunity to breach species barriers (box). Humans have infringed on animal habitats and international trade has lengthened supply chains,[8] but one of the most important changes is the increased human demand for meat and animal products and consequent increase in animal husbandry, which is thought to be one significant cause of the increased emergence of novel influenza virus strains in Asia.[9 10]

Global response when disease strikes

Countries that are members of the World Health Organization are legally required to report to WHO

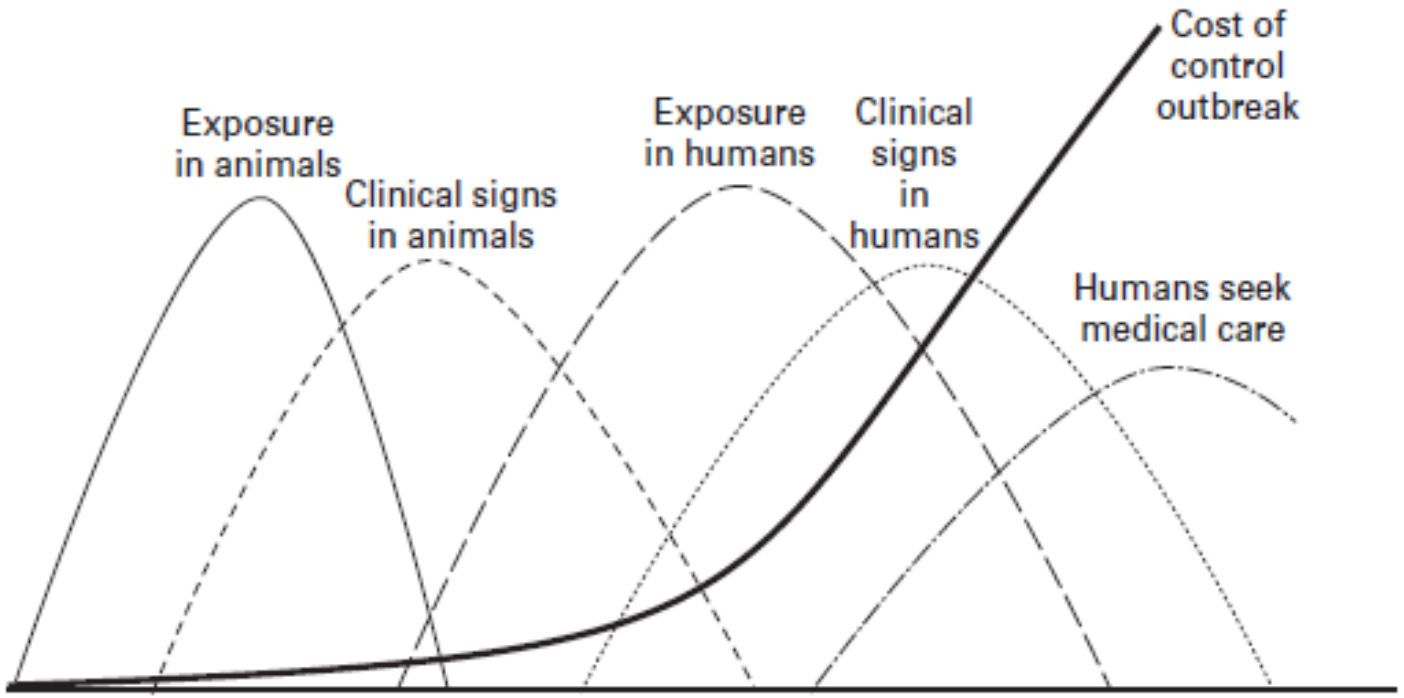
KEY MESSAGES

- Most emerging infectious diseases occur where animals meet humans
- The world's increased demand for meat has been one cause of disrupted ecosystems and increased the potential for emerging infections
- Since 2005 there has been a change of emphasis from control to prevention or minimisation at the source, but more must be done to show its cost effectiveness
- One Health brings together researchers and workers from health, agriculture, environment, and commerce to tackle the problem from all angles
- It is hoped that this approach will improve human health and reduce economic costs by preventing emerging infections at their source

AFP

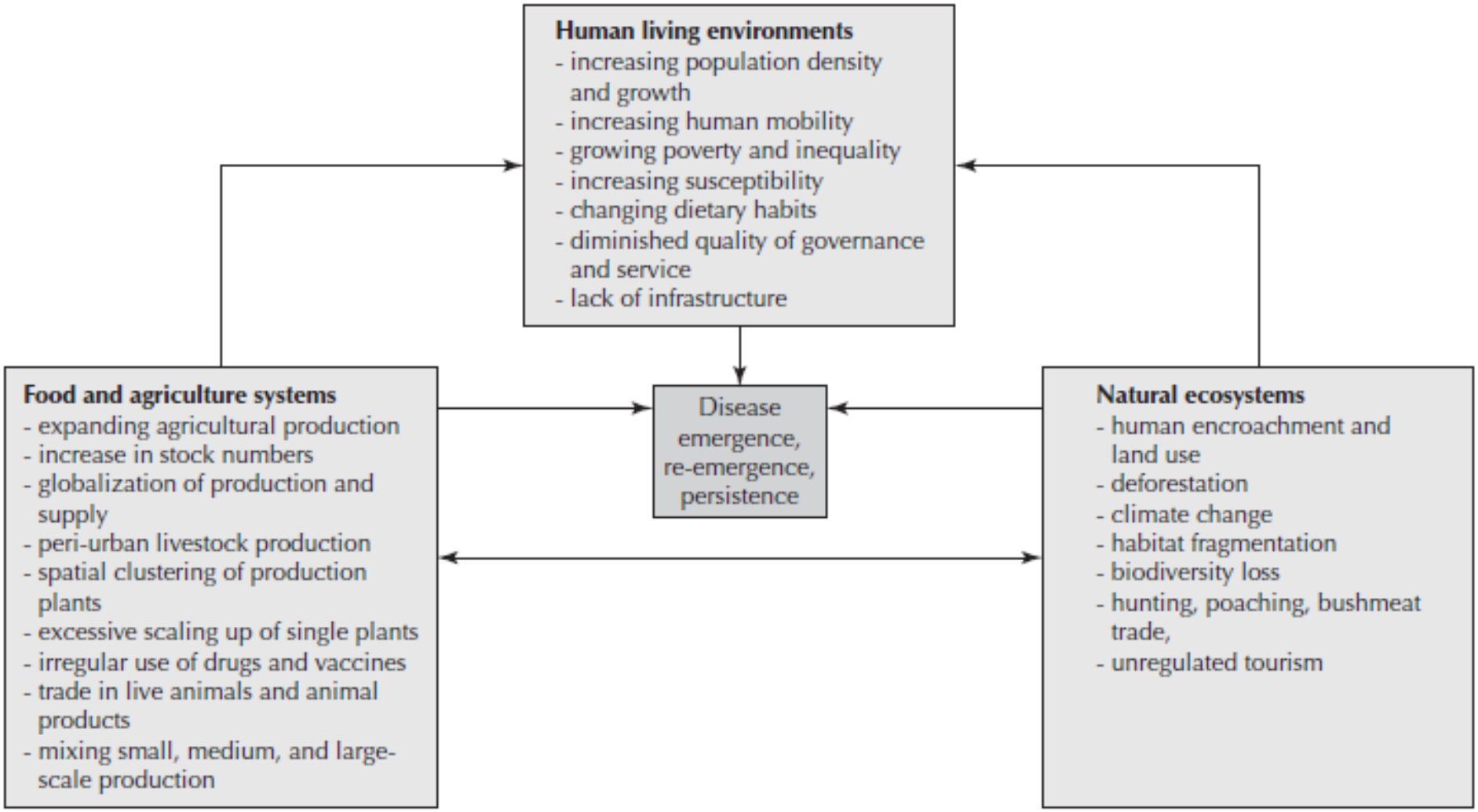
Disinfecting a duck enclosure in China in a bid to prevent the spread of bird flu

Early Control of Zoonotic Disease Is Both Cost-effective and Prevents Human Disease



Source: Adapted from IOM (2009).

Interplay of Three Health Domains



Source: Adapted from Institutes of Medicine 2009.

COMPLEX INTERRELATIONSHIPS between

- **Human and Animal hosts**
- **Microorganism**
- **Environmental factors that affect exposure and transmission**

Interaction Among Humans, Animals and the Environment

Factor (Cause)	Change (Effect)
Human populations are growing and expanding into new geographic areas.	**As a result, more people live in close contact with wild and domestic animals. Close contact provides more opportunities for diseases to pass between animals and people.**
The earth has experienced changes in climate and land use, such as deforestation and intensive farming practices.	**Disruptions in environmental conditions and habitats provide new opportunities for diseases to pass to animals.**
International travel and trade have increased.	**As a result, diseases can spread quickly across the globe.**

The global aviation network

Hufnagel L et al. *Proc Natl Acad Sci USA 2004*

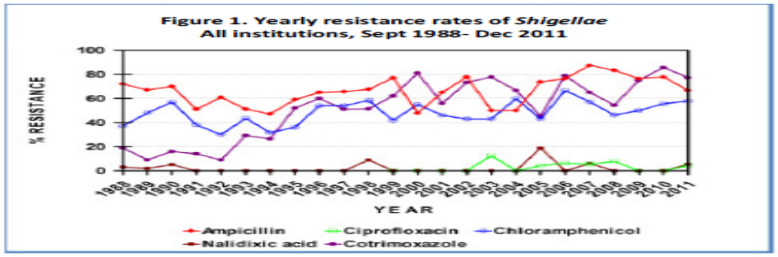
Growth in world population and international tourist travel

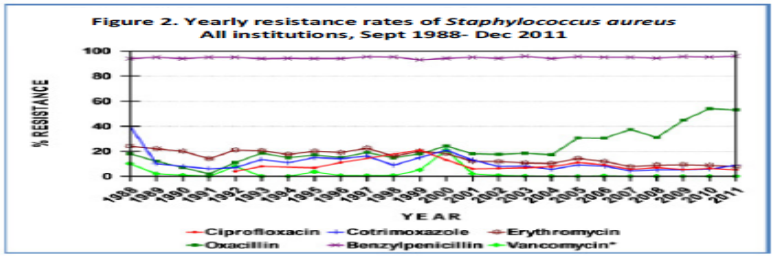
Year	World Population (in millions)	Int'l Tourist Arrivals (in millions)
1950	2,557	25.3
1985	4,852	329
1995	5,694	550
2007	6,600	898
2012	7,018	1,035
Change	2.7x	40.9x

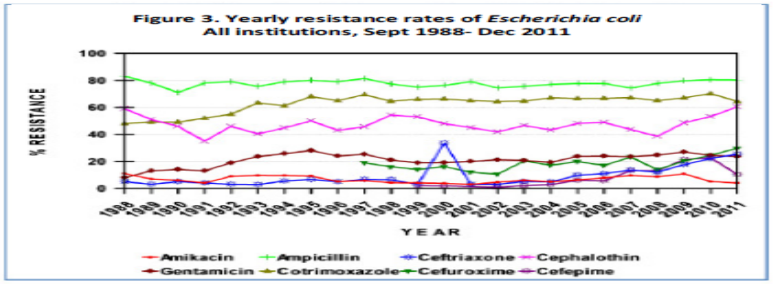
Adapted from: Chen LH & Wilson ME. Med Clin N Am 2008; 1409-32 and unwto.org

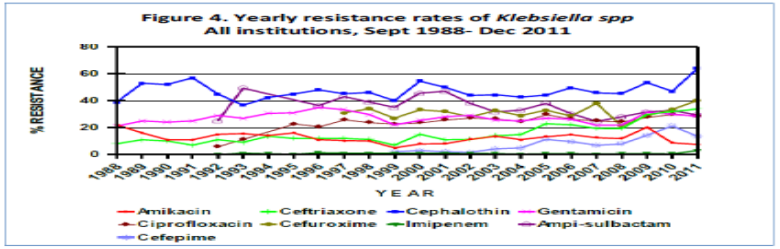
The Antibiotic Resistance Surveillance Program (ARSP)

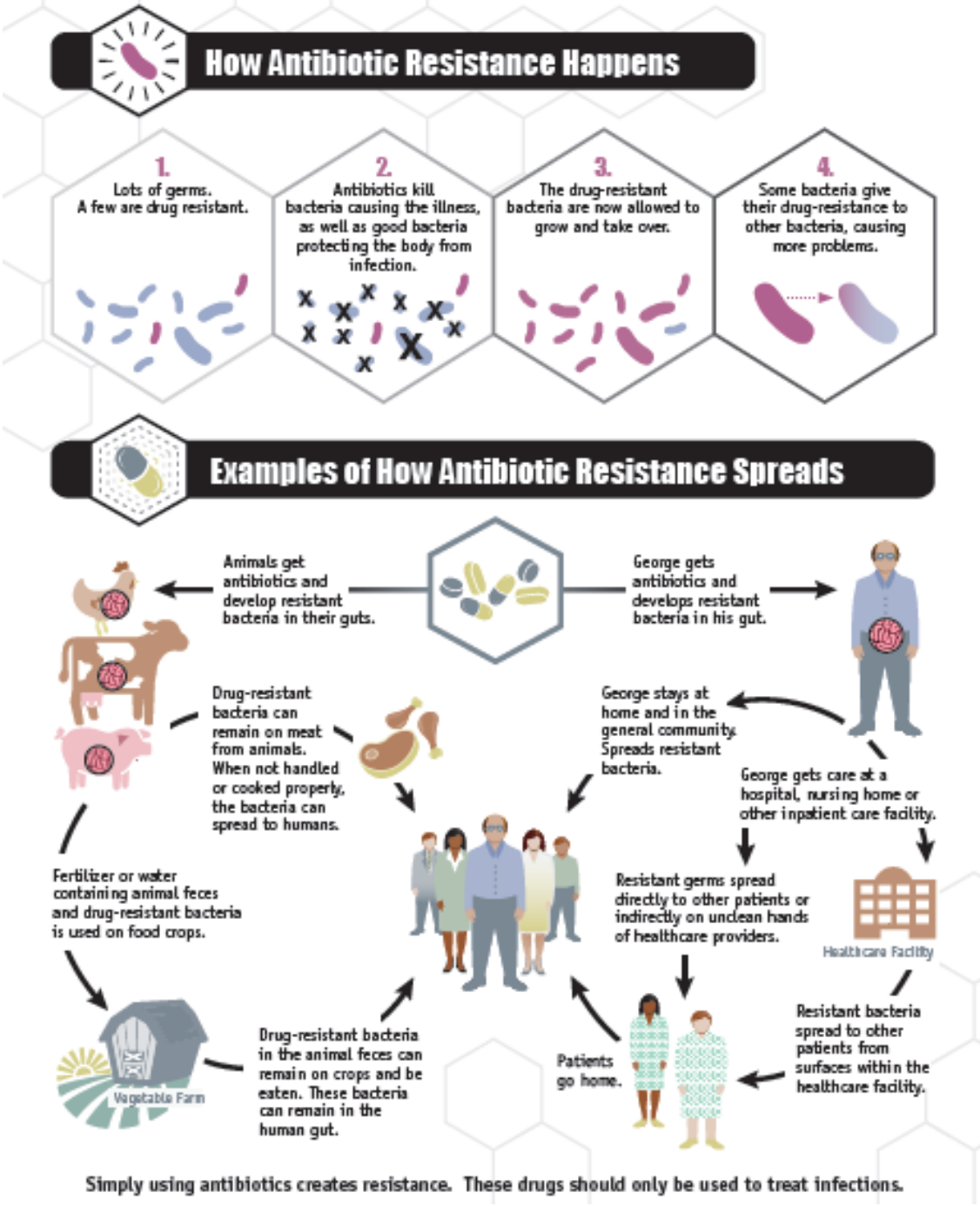
- **Very alarming rates of resistance among various pathogens**
  - ***Escherichia coli***
  - ***Klebsiella* spp.**
  - ***Pseudomonas aeruginosa***
  - ***Acinetobacter* spp.**
  - ***Streptococcus pneumoniae***
  - ***Staphylococcus aureus***
  - ***Neisseria gonorrheae***










How Antibiotic Resistance Happens
1.
Lots of germs.
A few are drug resistant.
2.
Antibiotics kill bacteria causing the illness, as well as good bacteria protecting the body from infection.
3.
The drug-resistant bacteria are now allowed to grow and take over.
4.
Some bacteria give their drug-resistance to other bacteria, causing more problems.
Examples of How Antibiotic Resistance Spreads
Animals get antibiotics and develop resistant bacteria in their guts.
George gets antibiotics and develops resistant bacteria in his gut.
Drug-resistant bacteria can remain on meat from animals. When not handled or cooked properly, the bacteria can spread to humans.
George stays at home and in the general community. Spreads resistant bacteria.
George gets care at a hospital, nursing home or other inpatient care facility.
Fertilizer or water containing animal feces and drug-resistant bacteria is used on food crops.
Resistant germs spread directly to other patients or indirectly on unclean hands of healthcare providers.
Healthcare Facility
Vegetable Farm
Drug-resistant bacteria in the animal feces can remain on crops and be eaten. These bacteria can remain in the human gut.
Patients go home.
Resistant bacteria spread to other patients from surfaces within the healthcare facility.
Simply using antibiotics creates resistance. These drugs should only be used to treat infections.

Four Core Actions to Prevent Antibiotic Resistance

1 PREVENTING INFECTIONS, PREVENTING THE SPREAD OF RESISTANCE

Avoiding infections in the first place reduces the amount of antibiotics that have to be used and reduces the likelihood that resistance will develop during therapy. There are many ways that drug-resistant infections can be prevented: immunization, safe food preparation, handwashing, and using antibiotics as directed and only when necessary. In addition, preventing infections also prevents the spread of resistant bacteria.

2 TRACKING

CDC gathers data on antibiotic-resistant infections, causes of infections and whether there are particular reasons (risk factors) that caused some people to get a resistant infection. With that information, experts can develop specific strategies to prevent those infections and prevent the resistant bacteria from spreading.

3 IMPROVING ANTIBIOTIC PRESCRIBING/STEWARDSHIP

Perhaps the single most important action needed to greatly slow down the development and spread of antibiotic-resistant infections is to change the way antibiotics are used. Up to half of antibiotic use in humans and much of antibiotic use in animals is unnecessary and inappropriate and makes everyone less safe. Stopping even some of the inappropriate and unnecessary use of antibiotics in people and animals would help greatly in slowing down the spread of resistant bacteria. This commitment to always use antibiotics appropriately and safely—only when they are needed to treat disease, and to choose the right antibiotics and to administer them in the right way in every case—is known as antibiotic stewardship.

4 DEVELOPING NEW DRUGS AND DIAGNOSTIC TESTS

Because antibiotic resistance occurs as part of a natural process in which bacteria evolve, it can be slowed but not stopped. Therefore, we will always need new antibiotics to keep up with resistant bacteria as well as new diagnostic tests to track the development of resistance.

WHO Six-Point Policy Package to Combat AMR

During the 62nd WHO regional Committee Meeting in October 2011, the Philippines committed to implementing the six-point policy agenda to combat AMR

Policy Areas

(1) Committing to develop a master plan to combat antimicrobial resistance

(2) Strengthening surveillance and laboratory capacity

(3) Ensuring uninterrupted access to essential medicines of assured quality

(4) Promoting rational use of medicines in patient care and animal husbandry

(5) Enhancing infection prevention and control

(6) Fostering innovations and research to develop new tools and drugs

MALACAÑAN PALACE
MANILA

BY THE PRESIDENT OF THE PHILIPPINES

ADMINISTRATIVE ORDER NO. 42

CREATING AN INTER-AGENCY COMMITTEE FOR THE FORMULATION AND IMPLEMENTATION OF A NATIONAL PLAN TO COMBAT ANTIMICROBIAL RESISTANCE IN THE PHILIPPINES

WHEREAS, antimicrobial resistance (AMR) has been identified by the World Health Organization (WHO) and the World Organization on Animal Health, as well as other policy-makers, scientists, professionals, and civil society groups, as a global threat to humankind and animal health because it reduces the effectiveness of antimicrobial medicines;

WHEREAS, AMR has serious health and economic consequences, such as increased mortality, prolonged illness, increased cost of health care, and adverse impact on trade and foreign affairs;

WHEREAS, there is a need to ensure efficient government response to control AMR through the formulation, adoption, and implementation of a comprehensive national plan that would integrate, coordinate, and develop sustainable and collaborative systems and mechanisms to combat AMR in the Philippines;

WHEREAS, the creation of an inter-agency committee to formulate and implement the plan can rationalize, harmonize, streamline, integrate, and unify the efforts of government agencies to address the AMR problem; and

WHEREAS, the Philippines has committed to the WHO Six-Point Health Policy Agenda as a response to the efforts to control and prevent AMR.

NOW, THEREFORE, I, BENIGNO S. AQUINO III, President of the Philippines, by virtue of the powers vested in me by law, do hereby order:

SECTION 1. Creation and Composition. The Inter-Agency Committee (hereinafter referred to as the Committee) is hereby created, to be composed of representatives from the following:

Co-Chairs: Department of Health (DOH)
Department of Agriculture (DA)

Members : Department of Science and Technology (DOST)
Department of the Interior and Local Government (DILG)
Department of Trade and Industry (DTI)

DOH shall provide secretariat support to the Committee.

THE PRESIDENT OF THE PHILIPPINES

Administrative Order no 42 s. 2014 was signed by HE President Benigno Aquino in April 2014 mandating the creation of a duly constituted body (Interagency Committee on AMR) that will formulate and oversee the implementation of a *comprehensive national AMR plan*.

National Antimicrobial Stewardship (AMS) Program

WIN THE WAR AGAINST AMR

- aimed at ensuring rational prescribing, dispensing and use of antimicrobials in the country

EBOLA RESPONSE ROAD MAP - WHO

Goal: Stop Ebola transmission in affected countries within 6-9 months and prevent international spread.

- **The roadmap will assist governments and partners in the revision and resourcing of country-specific operational plans for Ebola response, and the coordination of international support for their full implementation.**

Objectives:

- **to achieve full geographic coverage with complementary Ebola response activities in countries with widespread and intense transmission**
- **to ensure emergency and immediate application of comprehensive Ebola response interventions in countries with an initial case(s) or with localized transmission**
- **to strengthen preparedness of all countries to rapidly detect and respond to an Ebola exposure, especially those sharing land borders with an intense transmission area and those with international transportation hubs.**

Key interventions to stop EVD transmission

1. Early isolation of patients to prevent transmission at home and in the community
    - In addition to isolation, Ebola treatment centres provide safe care and psychosocial support and contribute to surveillance through identification of contacts

2. Early detection of new Ebola cases through close monitoring of contacts and isolation of contacts when they show symptoms

3. Safe burials: to reduce transmission through contact with dead bodies, whether during preparation of the body for burial or during the funeral ceremony

Laboratory diagnostic and social mobilization are critical to support the above mentioned interventions

Republic of the Philippines
Department of Health
OFFICE OF THE SECRETARY

August 26, 2014

DEPARTMENT MEMORANDUM
No. 2014 - 0257

FOR: **DOH Bureaus, Services, Centers for Health Development (CHDs), Hospitals, the Research Institute for Tropical Medicine and Attached Agencies, All Services, Units and Teams, Designated to Work for the Prevention and Control of the Ebola Virus Disease and All Others Concerned**

SUBJECT: **Interim Guidelines on Prevention and Control of Ebola Virus Disease**

Enrique T. Ona, MD, FPCS, FACS
Secretary of Health

DOH MEMORANDA

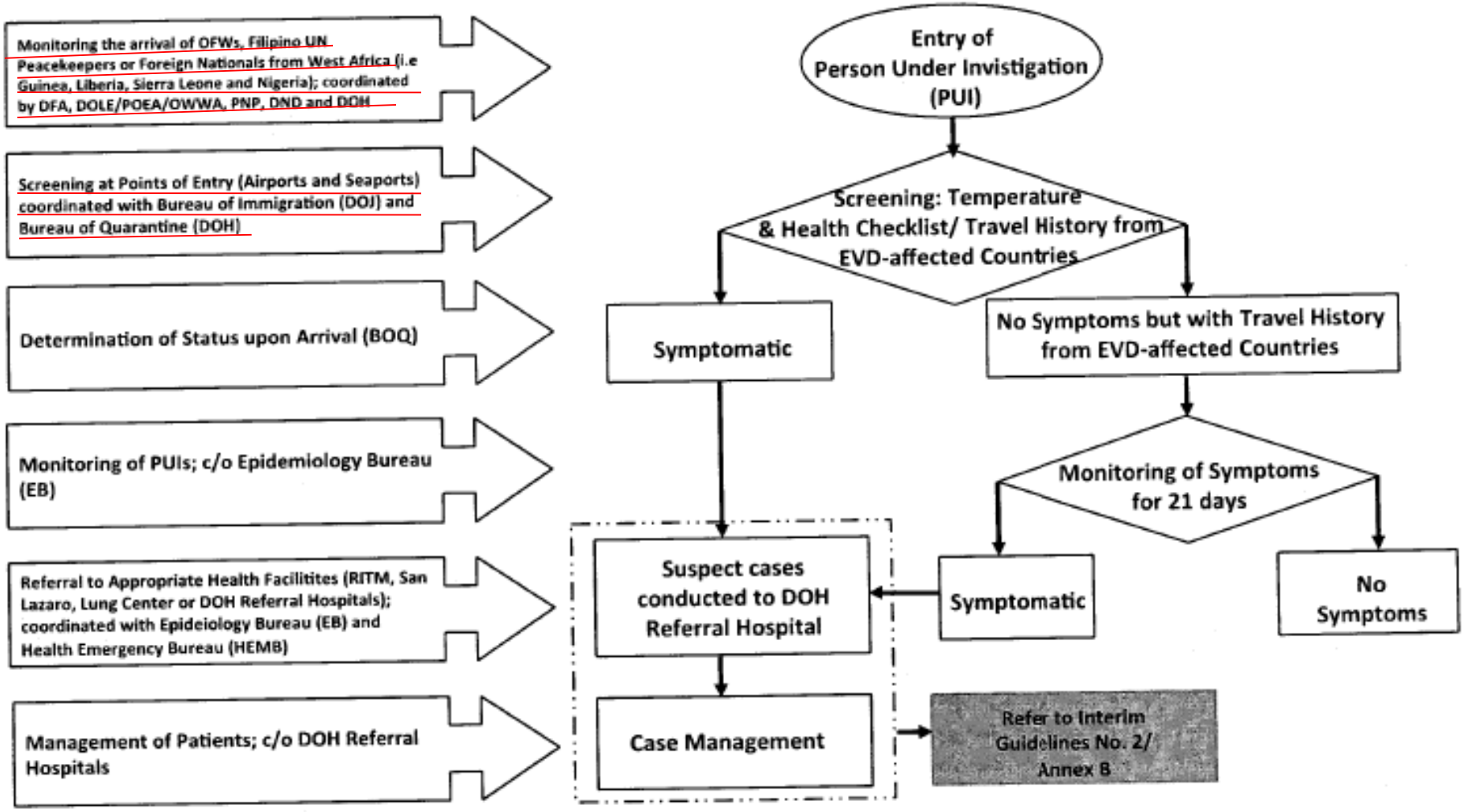
- Department Memorandum No. 2014 – 0257
  - Interim Guidelines on Prevention and Control of Ebola Virus Disease
- Department Memorandum No. 2014 – 0291
  - Interim Guidelines for Ensuring the Health Security of Overseas Filipino Workers in West African Countries and of Filipino UN Peacekeepers in Liberia against Ebola Virus Disease.

INTERIM GUIDELINES FOR PREVENTION AND CONTROL OF EBOLA VIRUS DISEASE

- **Inter-Agency Coordination on Prevention or Minimization of Entry and Spread of EBOLA Virus**
- **Procedures for Isolation, Case Management and Infection Control for EVD**
- **EBOLA Virus Disease Surveillance and Reporting**

ANNEX A

ALGORITHM FOR PREVENTION OR MINIMIZATION OF ENTRY AND SPREAD OF EBOLA VIRUS DISEASE



HOW EFFECTIVE IS EXIT vs ENTRY SCREENING OF TRAVELLERS AT COMMERCIAL AIRPORTS?

Assessment of the potential for international dissemination of Ebola virus via commercial air travel during the 2014 west African outbreak

Isaac I Bogoch, Maria I Creatore, Martin S Cetron, John S Brownstein, Nicki Pesik, Jennifer Miniota, Theresa Tam, Wei Hu, Adriano Nicolucci, Saad Ahmed, James W Yoon, Isha Berry, Simon Hay, Aranka Anema, Andrew J Tatem, Derek MacFadden, Matthew German, Kamran Khan

Summary

Background The WHO declared the 2014 west African Ebola epidemic a public health emergency of international concern in view of its potential for further international spread. Decision makers worldwide are in need of empirical data to inform and implement emergency response measures. Our aim was to assess the potential for Ebola virus to spread across international borders via commercial air travel and assess the relative efficiency of exit versus entry screening of travellers at commercial airports.

Methods We analysed International Air Transport Association data for worldwide flight schedules between Sept 1, 2014, and Dec 31, 2014, and historic traveller flight itinerary data from 2013 to describe expected global population movements via commercial air travel out of Guinea, Liberia, and Sierra Leone. Coupled with Ebola virus surveillance data, we modelled the expected number of internationally exported Ebola virus infections, the potential effect of air travel restrictions, and the efficiency of airport-based traveller screening at international ports of entry and exit. We deemed individuals initiating travel from any domestic or international airport within these three countries to have possible exposure to Ebola virus. We deemed all other travellers to have no significant risk of exposure to Ebola virus.

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See Online/Comment
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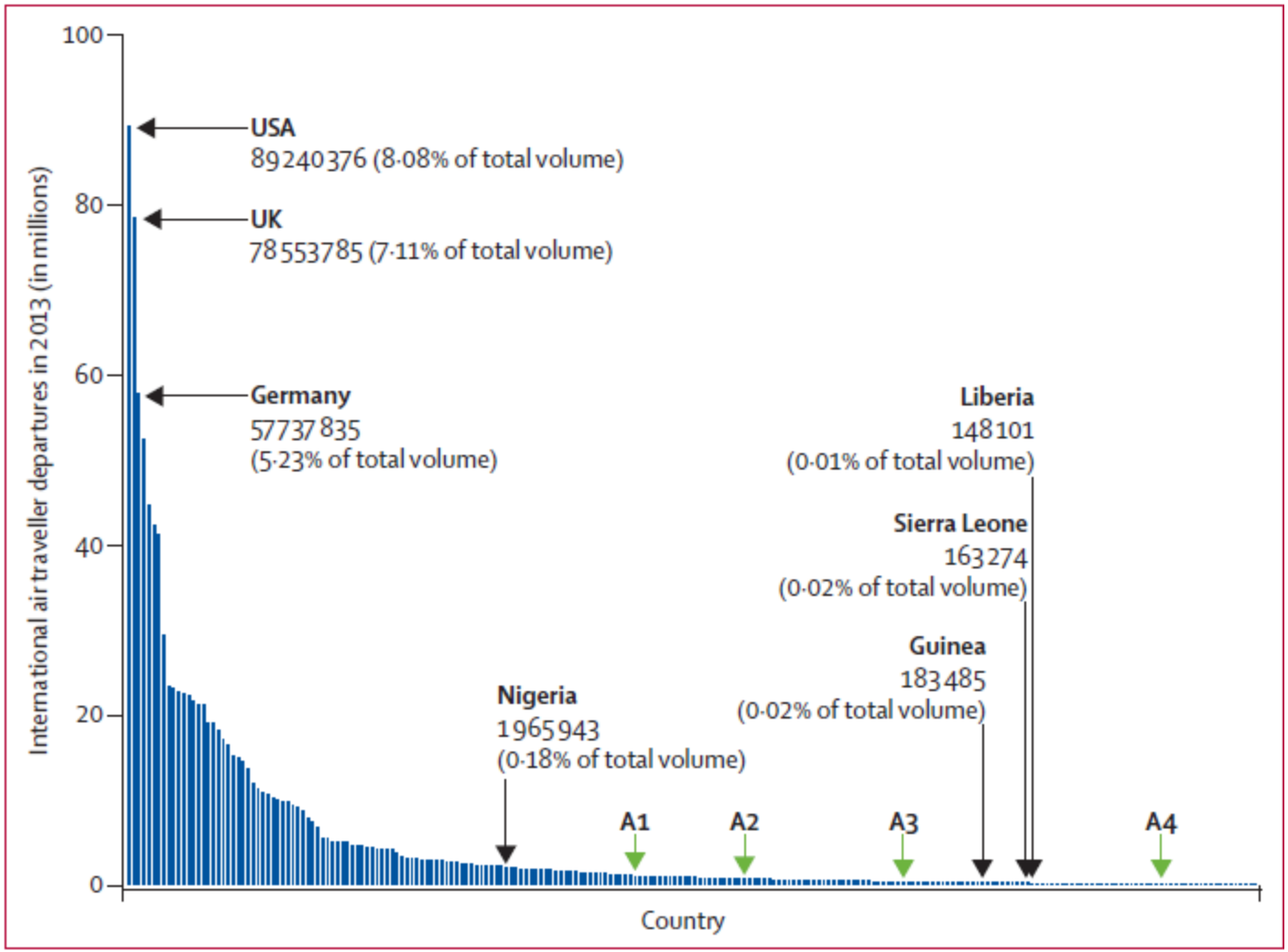
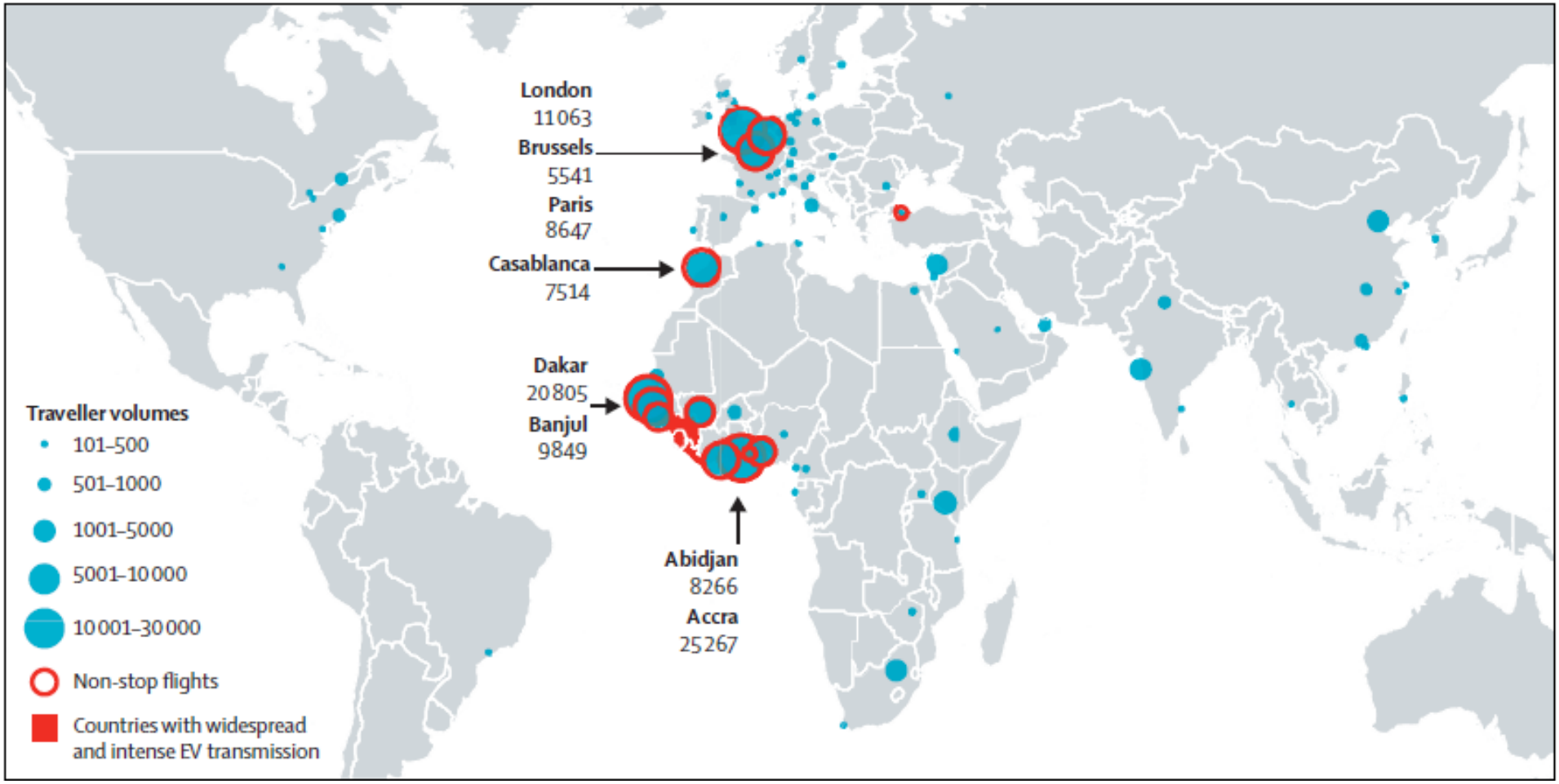
Department of Medicine, Division of Infectious Diseases, University of Toronto, Toronto, ON, Canada (I I Bogoch MD, D MacFadden MD, K Khan MD); **Divisions of Internal Medicine and Infectious Diseases, University Health Network, Toronto, ON, Canada** (I I Bogoch); **Centre for Research**



Global volume of international air traveller departures by country, 2013

Countries are shown in decreasing order of air traffic volume. Countries sharing a land border with Guinea, Liberia, and Sierra Leone are shown by green arrows. A1=Senegal (1 022 058; 0·09% of total volume). A2=Côte d'Ivoire (663 438; 0·06% of total volume), A3=Mali (325 983; 0·03% of total volume). A4=Guinea-Bissau (45 702; <0·01% of total volume).



Final traveler destinations, passenger volumes * and scheduled non-stop flights† departing Guinea, Liberia, an d Sierra Leone.

***From Sept 1, 2013, to Dec 31, 2013. †From Sept 1, 2014, to Dec 31, 2014.**

Assessment of the potential for international dissemination of Ebola virus via commercial air travel during the 2014 west African outbreak

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- **Objective: To assess the potential for EBOLA to spread across int'l borders via commercial travel**
- **Methods: Modelling based on IATA flight sked data (Sept-Dec 2014) and flight itinerary data from 2013**
- **Assumption: Travelers initiating travel from Liberia, Guinea, Sierra leone have possible exposure**
- **Findings: Exit screening of travelers at airports in these 3 countries would be the most efficient frontier at which to assess the health status of travelers at risk of exposure**
- **Analyses could assist countries in making decisions that balance theirs risks from importing Ebola vs potential harms to affected countries by disrupting int'l travel and trade**

ANNEX A-1

ACTIVITIES FOR PREVENTION OR MINIMIZATION OF ENTRY AND SPREAD OF EBOLA VIRUS DISEASE

STEP	ACTIVITY
1. Monitoring of Arrival of OFWs, Filipino UN Peacekeepers or Foreign Nationals from West Africa (i.e Guinea, Liberia, Sierra Leone & Nigeria)	• **Foreign Service Posts(FSPs)** and **Labor Attachés** instruct recruitment agencies to advise OFWs and their employers about Philippine government's recommendation of repatriation or mandatory evacuation in Guinea, Liberia and Sierra Leone • Names, flight and travel details and contact information of OFWs forwarded by recruitment agencies to DOLE/POEA, DFA and DOH; info forwarded to **Bureau of Quarantine(BOQ)** for monitoring of arrivals and to the **Epidemiology Bureau (EB)** for monitoring of asymptomatic individuals • Those who may have fever, headache, intense weakness, joint and muscle pains & sore throat should seek clearance with local health authorities from country of origin before being allowed to embark as part of the country's exit screening protocol
2. Screening at Points of Entry (Airports and Seaports)	• Distribute the Health Checklist to passengers from all incoming flights to the Philippines. • Provide passengers from affected areas with a notification card to facilitate consultation and laboratory testing should they manifest any symptom during their 21-day monitoring period (c/o EB-DOH) • Coordinate with and provide feedback to DOLE/POEA on verifying arrivals of repatriated OFWs • Coordinate with PNP/AFP regarding arrival of Filipino U.N. Peacekeepers • BI to screen for recent travel history from EVD-affected countries of non-repatriated OFWs &foreign nationals&coordinate with BOQ
3. Determination of Status upon Arrival	• Determine the health status of returning Filipinos upon arrival (i.e. presence of fever and other symptoms) and refer symptomatic cases to the appropriate health facilities for clinical care (RITM, San Lazaro, Lung Center)
4. Monitoring of PUIs	• After screening by **BOQ**, asymptomatic individuals will be closely monitored daily for occurrence of fever &other Ebola symptoms by **Epidemiology Bureau (EB) &Regional Epidemiology Surveillance Units (RESUs)** up to 21 days from potential exposure or arrival in the Philippines(Refer to **Interim Guidelines No. 3: Ebola Virus Disease Surveillance and Reporting**) • Once an individual is found to be symptomatic during the 21-day monitoring period, **EB** will coordinatewith the **RESU, Health Emergency and Management Bureau (HEMB)** and **HEMB Regional Coordinators** from the **DOH Regional Offices(DOH ROs)** and health officials of LGUs to facilitate pick up of patients and conduction to DOH SARS Referral Hospitals (based on **DOH AO No. 45 s. 2003: Designation of the DOH Hospitals as SARS REFERRAL HOSPITALS**) • **EB/RESU** will also organize possible contact tracing and conduct the necessary epidemiologic investigation
5. Referral to Appropriate Health Facilities	• For arrivals at the **Ninoy Aquino International Airport (NAIA)**, symptomatic cases will be conducted by ambulance to the **Research Institute for Tropical Medicine (RITM);** other DOH referral facilities in Metro Manila are **San Lazaro Hospital** and **Lung Center of the Philippines**; refer to **Annex B-1** for DOH SARS Referral Hospitals
6. Management of Patients	• Refer to **Interim Guidelines No. 2 and Annex B: Procedures for Isolation, Case Management and Infection Control for Ebola Virus Disease**

TO QUARANTINE OR NOT

- Philippine OFWs
  - 200 Liberia
  - 511 Guinea
  - 1044 Sierra Leone

145 UN Peacekeepers in Liberia

Interim U.S. Guidance for Monitoring and Movement of Persons with Potential Ebola Virus Exposure

Updated: October 29, 2014

The world is facing the biggest and most complex Ebola outbreak in history. On August 8, 2014, the Ebola outbreak in West Africa was declared by the World Health Organization (WHO) to be a Public Health Emergency of International Concern (PHEIC) because it was determined to be an 'extraordinary event' with public health risks to other countries. The possible consequences of further international spread are particularly serious considering the following factors:

1. the virulence (ability to cause serious disease or death) of the virus,
2. the widespread transmission in communities and healthcare facilities in the currently affected countries, and
3. the strained health systems in the currently affected and most at-risk countries.

Coordinated public health actions are essential to stop and reverse the spread of Ebola. Healthcare workers who take care of patients with Ebola are not only helping the nations facing the Ebola outbreak but also protecting people in the United States by helping to fight the outbreak at its source. The risk in this country will only be fully addressed when the current outbreak in Africa is over, and the participation of US and other healthcare workers from outside of the countries with widespread transmission is essential to control the disease.

With the complex nature and seriousness of the outbreak, CDC has created interim guidance for monitoring people potentially exposed to Ebola and for evaluating their intended travel, including the application of movement restrictions when indicated. This interim guidance has been updated by establishing a "low (but not zero) risk" category; adding a "no identifiable risk" category; modifying the recommended public health actions in the high, some, and low (but not zero) risk categories; and adding recommendations for specific groups and settings.

Summary of CDC Interim Guidance for Monitoring and Movement of People Exposed to Ebola Virus

Exposure Category	Clinical Criteria	Public Health Actions

High risk includes any of the following:
• Percutaneous (e.g., needle stick) or mucous membrane exposure to blood or body fluids of a person with Ebola while the person was symptomatic
• Exposure to the blood or body fluids (including but not limited to feces, saliva, sweat, urine, vomit, and semen) of a person with Ebola while the person was symptomatic without appropriate personal protective equipment (PPE)
• Processing blood or body fluids of a person with Ebola while the person was symptomatic without appropriate PPE or standard biosafety precautions
• Direct contact with a dead body without appropriate PPE in a country with widespread Ebola virus transmission
• Having lived in the immediate household and provided direct care to a person with Ebola while the person was symptomatic
	Fever (subjective fever or measured temperature ≥100.4°F/38°C) OR any of the following:*
	• severe headache
	• muscle pain
	• vomiting
	• diarrhea
	• stomach pain
	• unexplained bruising or bleeding
		• Implement rapid isolation with immediate contact of public health authorities to arrange for safe transport to an appropriate healthcare facility for Ebola evaluation
		• Medical evaluation is required.
		  ○ Isolation orders may be used to ensure compliance
		  ○ Air travel is permitted only by air medical transport
		• If medically evaluated and discharged with a diagnosis other than Ebola, conditions as outlined for asymptomatic individuals in this exposure category will apply

	Asymptomatic (no fever or other symptoms consistent with Ebola)	• Direct active monitoring
		• Public health authority will ensure, through orders as necessary, the following minimum restrictions:
		  ○ Controlled movement: exclusion from all long-distance and local public conveyances (aircraft, ship, train, bus, and subway)
		  ○ Exclusion from public places (e.g., shopping centers, movie theaters), and congregate gatherings
		  ○ Exclusion from workplaces for the duration of the public health order, unless approved by the state or local health department (telework is permitted)
		• Non-congregate public activities while maintaining a 3-foot distance from others may be permitted (e.g., jogging in a park)
		• Federal public health travel restrictions (Do Not Board) will be implemented to enforce controlled movement
		• If travel is allowed, individuals are subject to controlled movement
		  ○ Travel by noncommercial conveyances only
		  ○ Coordinated with public health authorities at both origin and destination
		  ○ Uninterrupted direct active monitoring

Summary of CDC Interim Guidance for Monitoring and Movement of People Exposed to Ebola Virus

Exposure Category	Clinical Criteria	Public Health Actions

Some risk includes any of the following:
• In countries with widespread Ebola virus transmission: direct contact while using appropriate PPE with a person with Ebola while the person was symptomatic
• Close contact in households, healthcare facilities, or community settings with a person with Ebola while the person was symptomatic
  ○ Close contact is defined as being for a prolonged period of time while not wearing appropriate PPE within approximately 3 feet (1 meter) of a person with Ebola while the person was symptomatic
	Fever (subjective fever or measured temperature ≥100.4°F/38°C) OR any of the following:*
	• severe headache
	• muscle pain
	• vomiting
	• diarrhea
	• stomach pain
	• unexplained bruising or bleeding
		• Implement rapid isolation with immediate contact of public health authorities to arrange for safe transport to an appropriate healthcare facility for Ebola evaluation
		• Medical evaluation is required
		  ○ Isolation orders may be used to ensure compliance
		  ○ Air travel is permitted only by air medical transport
		• If medically evaluated and discharged with a diagnosis other than Ebola, conditions as outlined for asymptomatic individuals in this exposure category will apply

	Asymptomatic (no fever or other symptoms consistent with Ebola)	• Direct active monitoring
		• The public health authority, based on a specific assessment of the individual's situation, will determine whether additional restrictions are appropriate, including:
		  ○ Controlled movement: exclusion from long-distance commercial conveyances (aircraft, ship, train, bus) or local public conveyances (e.g., bus, subway)
		  ○ Exclusion from public places (e.g., shopping centers, movie theaters), and congregate gatherings
		  ○ Exclusion from workplaces for the duration of a public health order, unless approved by the state or local health department (telework is permitted)
		• Non-congregate public activities while maintaining a 3-foot distance from others may be permitted (e.g., jogging in a park)
		• Other activities should be assessed as needs and circumstances change to determine whether these activities may be undertaken
		• Any travel will be coordinated with public health authorities to ensure uninterrupted direct active monitoring
		• Federal public health travel restrictions (Do Not Board) may be implemented based on an assessment of the particular circumstance
		  ○ For travelers arriving in the United States, implementation of federal public health travel restrictions would occur after the traveler reaches the final destination of the itinerary

Summary of CDC Interim Guidance for Monitoring and Movement of People Exposed to Ebola Virus

Exposure Category	Clinical Criteria	Public Health Actions

Low (but not zero) risk includes any of the following:
• Having been in a country with widespread Ebola virus transmission within the past 21 days and having had no known exposures
• Having brief direct contact (e.g., shaking hands), while not wearing appropriate PPE, with a person with Ebola while the person was in the early stage of disease
• Brief proximity, such as being in the same room for a brief period of time, with a person with Ebola while the person was symptomatic
• In countries without widespread Ebola virus transmission: direct contact while using appropriate PPE with a person with Ebola while the person was symptomatic
• Traveled on an aircraft with a person with Ebola while the person was symptomatic
	Fever (subjective fever or measured temperature ≥100.4°F/38°C) OR any of the following:*
	• vomiting
	• diarrhea
	• unexplained bruising or bleeding
		• Implement rapid isolation with immediate contact of public health authorities to arrange for safe transport to an appropriate healthcare facility for Ebola evaluation
		• Medical evaluation is required.
		  ○ Isolation orders may be used to ensure compliance
		  ○ Air travel is permitted only by air medical transport
		• If medically evaluated and discharged with a diagnosis other than Ebola, conditions as outlined for asymptomatic individuals in this exposure category will apply

	Asymptomatic (no fever, vomiting, diarrhea, or unexplained bruising or bleeding)	• No restrictions on travel, work, public conveyances, or congregate gatherings
		• Direct active monitoring for:
		  ○ U.S.-based healthcare workers caring for symptomatic Ebola patients while wearing appropriate PPE
		  ○ Travelers on an aircraft with, and sitting within 3 feet of, a person with Ebola
		• Active monitoring for all others in this category

No identifiable risk includes: • Contact with an asymptomatic person who had contact with person with Ebola • Contact with a person with Ebola before the person developed symptoms • Having been more than 21 days previously in a country with widespread Ebola virus transmission • Having been in a country without widespread Ebola virus transmission and not having any other exposures as defined above	Symptomatic (any)	• Routine medical evaluation and management of ill persons, as needed
	Asymptomatic	• No actions needed

INTERIM GUIDELINES FOR PREVENTION AND CONTROL OF EBOLA VIRUS DISEASE

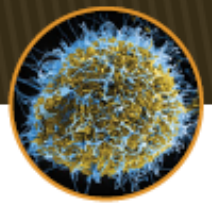
- **Inter-Agency Coordination on Prevention or Minimization of Entry and Spread of EBOLA Virus**
- **Procedures for Isolation, Case Management and Infection Control for EVD**
- **EBOLA Virus Disease Surveillance and Reporting**

Transmission of Ebola

Through direct contact :

- Blood or body fluids of an infected symptomatic person
- Splashes of body fluids
- Exposure to objects contaminated with infected secretions
  - needles
  - contaminated surfaces or equipment

Source: WHO, 2014



Ebola

What's the difference between infections spread through the air or by droplets?

Germs like chickpox and TB are spread through the air.

Airborne spread happens when a germ floats through the air after a person talks, coughs, or sneezes. Germs may land in the eyes, mouth, or nose of another person.

If a germ is airborne, direct contact with the infected person is NOT needed for someone else to get sick. Airborne spread diseases include: chickenpox, tuberculosis.

Ebola is spread through droplets.

Droplet spread happens when germs traveling inside droplets that are coughed or sneezed from a sick person enter the eyes, nose, or mouth of another person. Droplets travel short distances, less than 3 feet (1 meter) from one person to another.

A person might also get infected by touching a surface or object that has germs on it and then touching their mouth or nose.

Droplet spread diseases include: plague, Ebola.

Droplet spread on doorknob

How do I protect myself from getting sick?

- **Wash your hands** often with soap and water. If soap and water are not available, use an alcohol-based hand sanitizer.
- **Cover your cough!** Cover your nose and mouth with a tissue when you cough or sneeze. Throw the tissue in the trash after you use it.
- **Avoid close contact with people who are sick.**
- **Avoid touching your eyes, nose and mouth.** Germs spread this way.
- **Clean and disinfect commonly touched surfaces** like doorknobs, faucet handles, and toys, since the Ebola virus may live on surfaces for up to several hours.

Is Ebola airborne?

No. Ebola is not spread through the airborne route nor through water or food.

Is Ebola spread through droplets?

Yes. To get Ebola, you have to directly get body fluids (like pee, poop, spit, sweat, vomit, semen, breast milk) from someone who has Ebola in your mouth, nose, eyes or through a break in your skin or through sexual contact.

Air, food, and water do not carry the Ebola germs.

Centers for Disease Control and Prevention
Office of the Director

Personal protective equipment

PPE when handling a case of EVD

Both dressing and undressing should be supervised by a trained member of the team. These instructions should be displayed on the wall in the dressing and undressing room:

http://who.int/entity/csr/disease/ebola/put_on_ppequipment.pdf?ua=1

http://who.int/entity/csr/disease/ebola/remove_ppequipment.pdf?ua=1

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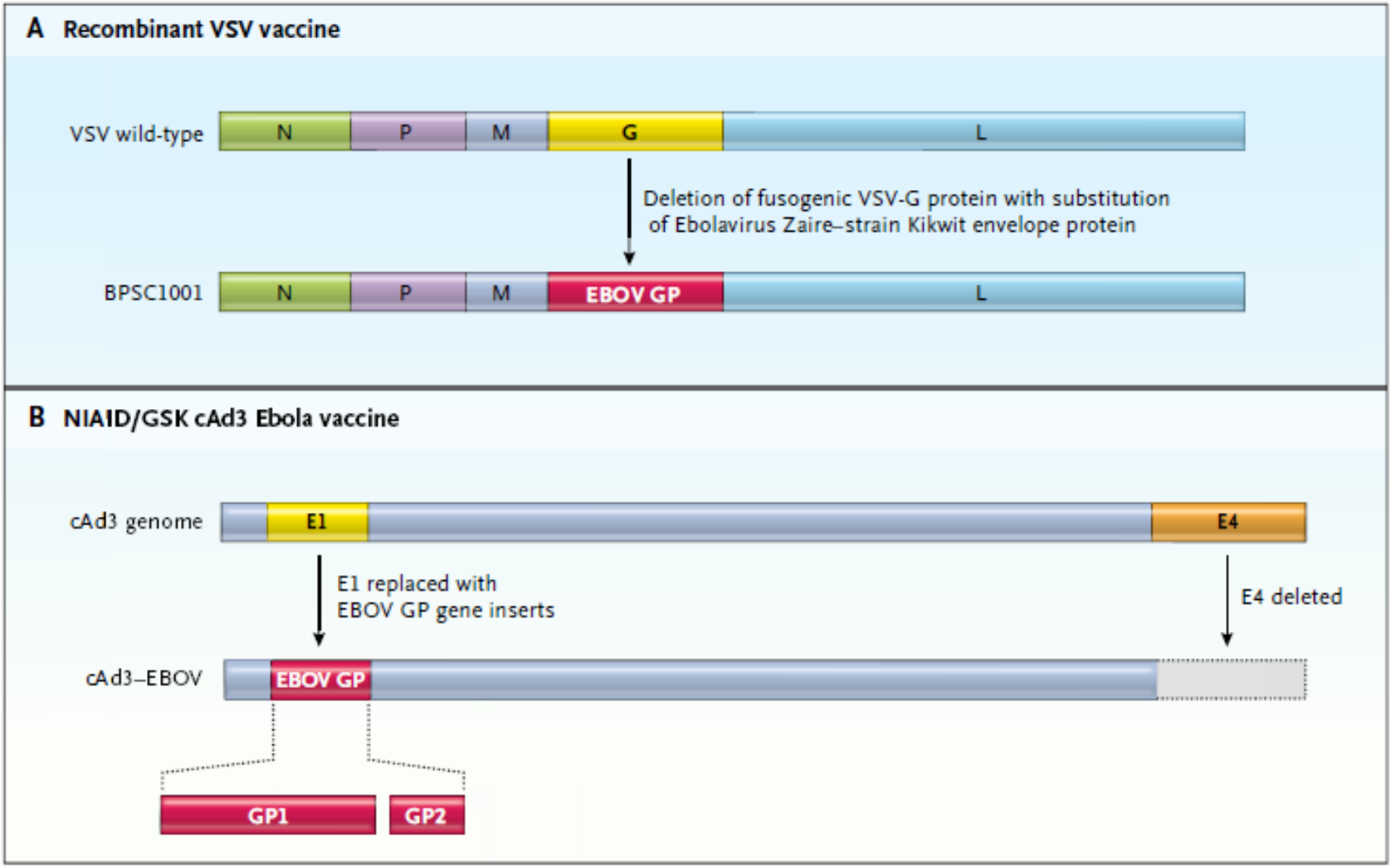
What is contact tracing?

Contact tracing can stop the Ebola outbreak in its tracks

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Contact tracing is finding everyone who comes in direct contact with a sick Ebola patient. Contacts are watched for signs of illness for 21 days from the last day they came in contact with the Ebola patient. If the contact develops a fever or other Ebola symptoms, they are immediately isolated, tested, provided care, and the cycle starts again—all of the new patient's contacts are found and watched for 21 days. **Even one missed contact can keep the outbreak going.**

Structures of Ebola Vaccine Candidates rVSV (Panel A) and cAd3 (Panel B)



Kanapathipilla R. et al. N Engl J Med 2014

Consolidated Ebola Virus Disease Preparedness Checklist

17 October 2014

World Health Organization

The Consolidated Checklist for Ebola Virus Disease Preparedness 2/2

Component	What this component is about	Why this needs to be in place and ready
Overall coordination	These are all efforts to clarify roles and responsibilities of national authorities and international partners in preparedness activities under a shared set of objectives.	This will allow to minimise duplication of efforts and ensure maximum impact from limited resources that are currently available.
Rapid Response Team (RRT)	RRT is a group of experienced experts that are on stand-by and can reach any part of the country within 24 hours. Their actions will help to contain/stop an outbreak early on. They will survey the first case(s), provide health care in a central facility, engage with the community and carry out infection, prevention and control measures.	As countries will not know exactly in which geographical area a first case will emerge, a fully operational RRT is critical to be able to act immediately once a suspicious case is reported. They will act as an initial stabilising resource in the earliest phase of the outbreak.
Public awareness and community engagement	These are efforts to promote the understanding of at risk communities on Ebola and address any stigma hampering EVD emergency healthcare and effective surveillance. Instead, the community has a crucial role in the alert.	In currently affected countries, health centres have been attacked as people were highly afraid and false rumours about the disease spread.
Infection Prevention and Control	This is to develop optimum IPC capacity and support facilities to ensure safe working conditions within healthcare facilities and social mobilization.	The ongoing epidemic in West Africa have caused considerable fatality of healthcare workers (average rate of infections 5-6%). IPC and safe working conditions are critical components to deliver emergency healthcare.
Case management a) Ebola Treatment Centre (ETC)	These are all efforts to develop or repurpose an existing facility as EVD ETC to treat 15 patients and have them fully operational. It includes the physical infrastructure as well as the capacities of staff to manage EVD cases.	The lack of functional ETCs in the beginning of an outbreak can lead to a small outbreak getting out of control. Therefore, having at least one fully operational ETC facility before a first case occurs is important to contain an outbreak early on.
Case management b) Safe burials	These are efforts to ensure safe burial with due regard to local custom and religion while safe handling of deceased is necessary to prevent wider transmission to communities.	Unsafe burial of Ebola victims has caused considerable community infection during burial ceremonies and is one of the main risk factors.
Epidemiological Surveillance	This is a cross-country effective alerting/notification system to immediately investigate a person for potential EVD.	The key to success in controlling EVD is largely dependent on timely and accurate community based surveillance.
Contact Tracing	These are all efforts that need to be in place to identify and track the chain of transmission within the first 72 of reporting a confirmed/suspected case.	Rapid contact tracing and immediate monitoring is essential to stop/limit the transmission to other people. .
Laboratory	These are all efforts to ensure that samples are safely taken and transported to laboratories which are ready to swiftly analyse them.	Rapid confirmation of cases is crucial to contain an outbreak, trace contacts and provide emergency healthcare.
Capacities at Points of Entry	Efforts to get Points of Entry ready to deal with an Ebola case once it occurs. This includes the preparation of facilities as well as increasing staff capacity.	An effective targeted screening at Point of Entries will help to prevent cross border transportation of infections.

The Global Threat of Epidemic Infectious Diseases

Projected Global Trends

- Asian countries will lead in economic growth
- Asian Cities will lead in population growth
  - Circular rural to urban migration
  - Increased globalization
  - Increased trade
  - Increased movement of people, animals and commodities
  - Increased movement of pathogens
  - Increased probability of epidemic disease
  - Increased threat to global economic security

Challenges: Addressing "Diseases without Borders" *(1)*

- **"One Health" approach because we are interconnected**
- **Effective global AND local surveillance, forecasting and preparedness *systems*:**
  - **Political commitment and cooperation/compliance**
  - **Capacity building for early detection/verification/reporting and preparedness**
  - **Improved infrastructure and tools, including rapid ICT**
- **Cross-disciplinary and cross-sectoral collaboration**

Challenges:
Addressing "Diseases without Borders" *(2)*

- **Shared resources: surveillance tools, sample specimens and genome sequencing, equitable access to new vaccines and antimicrobials**
- **"Push" and "pull" incentives for vaccine and antibiotic R&D**
- **Harness information technology and social media to engage the citizens of the world**

TURNING EVIDENCE INTO POLICY - Shifting the Paradigm on Emerging Infections

Obtaining data
- Current/past outbreaks

Understanding the determinants and risk factors through research
- Ecological and environmental
- Epidemiological and biological
- Socioeconomic and political
- Interdisciplinary risk assessments

Developing and testing mitigation strategies
- Modelling
- Trials
- Surveillance , prevention and control strategies

Policy uptake
- Submission of evidence to policy makers for discussion, review, implementation

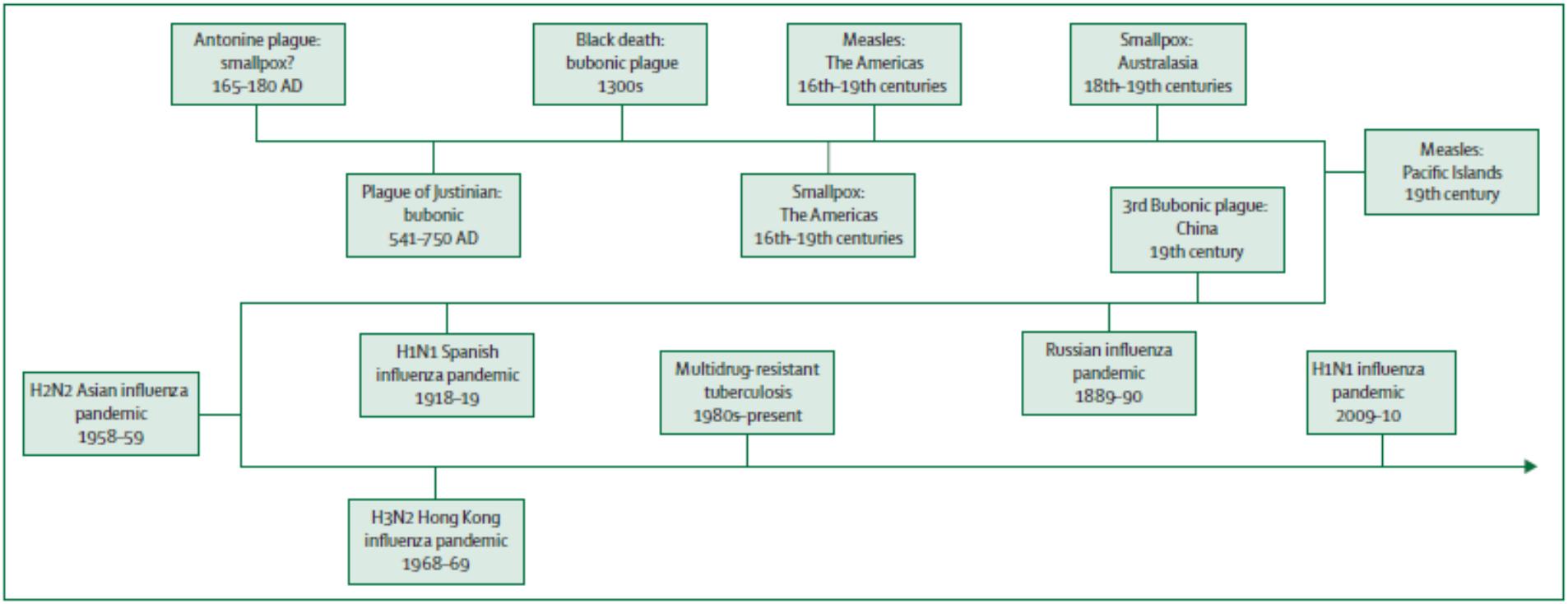
Adapted from McCloskey et al
Lancet Infect Dis 2014;14;1001-10

WILL WE EVER ELIMINATE EMERGING INFECTIOUS DISEASES?

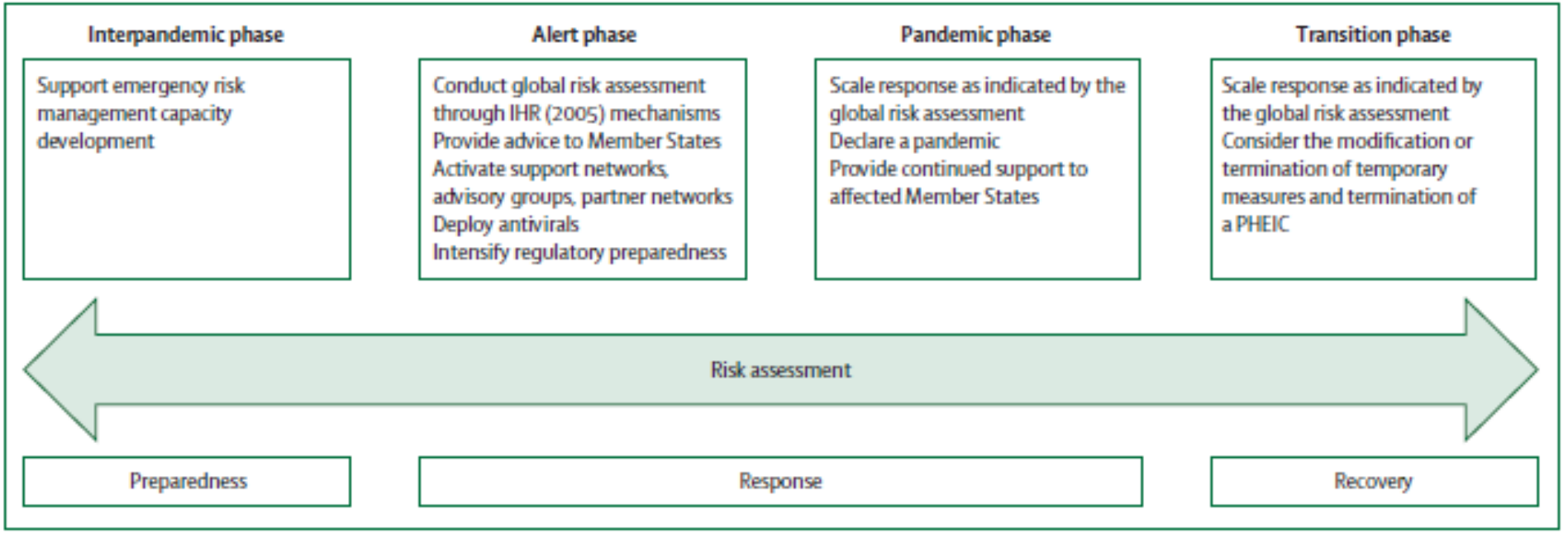
"Each new disease brings unique challenges, forcing us to continually adapt to ever-shifting threats. The battle against emerging infectious diseases is a continual process; winning does not mean stamping out every last disease, but rather getting out ahead of the next one."

Morens and Fauci

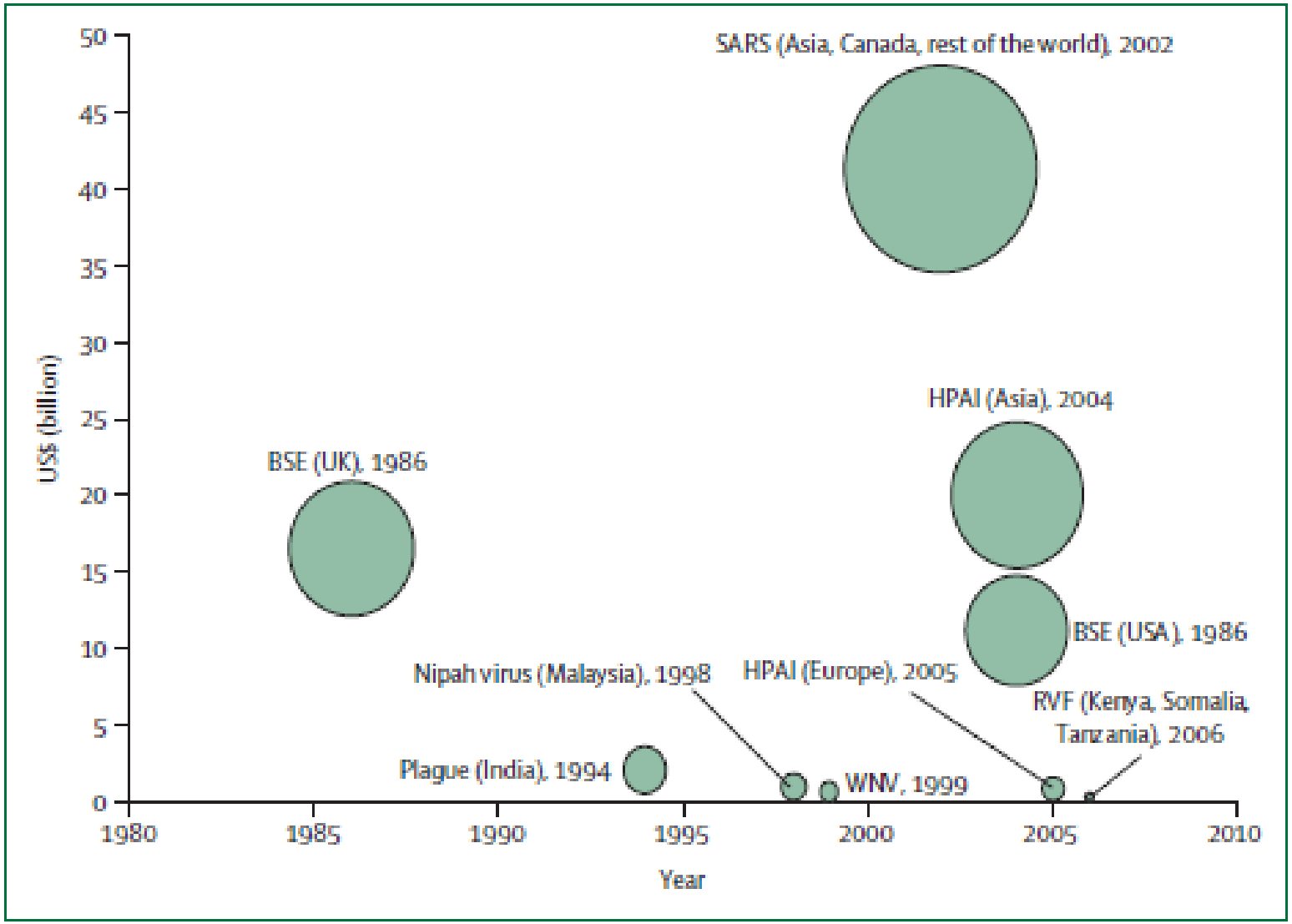
PLOS 2013



A timeline of major pandemics transmissible through the respiratory tract



WHO continuum of pandemic phases with actions for risk management



Estimated cost of selected emerging zoonotic diseases (1986–2006)

ECONOMIC AND SECTOR WORK

PEOPLE, PATHOGENS AND OUR PLANET

Volume 2

The Economics of One Health

JUNE 2012

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Prevention is better than cure for emerging infectious diseases

Emerging infectious diseases have the potential to cause considerable morbidity, mortality, and economic damage. **David Heymann** and **Osman Dar** explain why we need to shift the emphasis from responding to emerging infections once detected to preventing them from occurring in the first place

Emerging infectious diseases (emerging infections) have caused tens of billions of dollars' worth of damage in the past 20 years and the costs are continuing to rise.[1 2] Emerging infections can be new infections, such as HIV (when first discovered), which is thought to have emerged in human populations from a non-human primate; or existing infections that are becoming more common or spreading in geographically new areas as a result of changes in the micro-organisms or changing climate and include West Nile fever, Dengue fever, and chikungunya.[3]

Many people assume that emerging infections are a matter for tropical disease specialists, but they are important to doctors and policy makers, vets, farmers, traders, and economies globally. Although some emerging infections are specific to tropical areas, such as Ebola and Marburg haemorrhagic fevers, infections that emerge there can spread to other parts of the world, as seen with HIV. There are also many examples of diseases originating in non-tropical settings, including severe acute respiratory syndrome (SARS), influenza A (H5N1), variant Creutzfeldt-Jakob disease/bovine spongiform encephalopathy (BSE), and foodborne *Escherichia coli* O157 infections.[4 5] Another problem is infections that have emerged in new forms—for example, multidrug resistant staphylococcal and mycobacterial species.

Over the past decades there has been increasing recognition that the way we deal with infectious disease is often reactive and too late. New diseases are often identified only after they have transferred to humans and sometimes many years after the breach in the species barrier.[6] In this article we describe how doctors and other professions are beginning to work together to stop emerging infections earlier.

How do infectious diseases emerge?

A review of emerging infectious diseases in the past 60 years suggests that just under two thirds were transmitted from animals, with just over 70% of these from wild animals and the rest from domesticated animals.[1] For example, a recent emerging infection, Middle East respiratory syndrome coronavirus (MERS-CoV), which was first reported in 2012, may be associated with dromedary camels.[7] Globalisation and foreign travel have resulted in new convergences of people, animals, and the environment and have altered ecosystems, providing some microbes with the opportunity to breach species barriers (box). Humans have infringed on animal habitats and international trade has lengthened supply chains,[8] but one of the most important changes is the increased human demand for meat and animal products and consequent increase in animal husbandry, which is thought to be one significant cause of the increased emergence of novel influenza virus strains in Asia.[9 10]

Global response when disease strikes

Countries that are members of the World Health Organization are legally required to report to WHO

KEY MESSAGES

- Most emerging infectious diseases occur where animals meet humans
- The world's increased demand for meat has been one cause of disrupted ecosystems and increased the potential for emerging infections
- Since 2005 there has been a change of emphasis from control to prevention or minimisation at the source, but more must be done to show its cost effectiveness
- One Health brings together researchers and workers from health, agriculture, environment, and commerce to tackle the problem from all angles
- It is hoped that this approach will improve human health and reduce economic costs by preventing emerging infections at their source

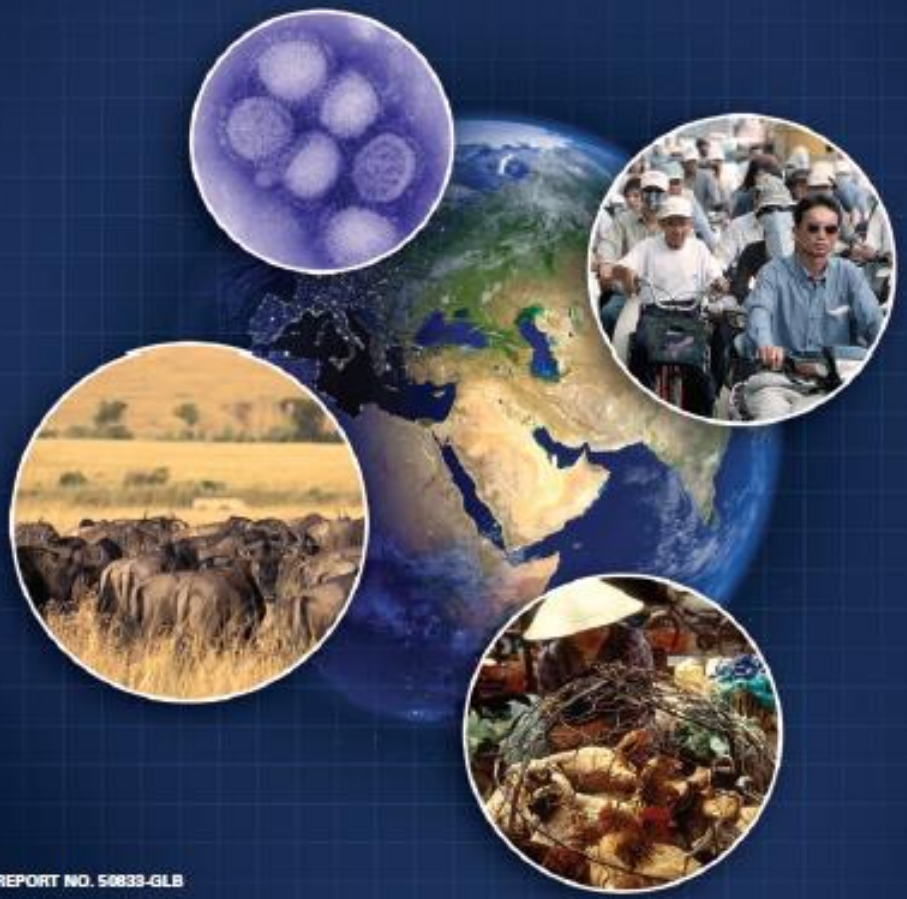
AFP

Disinfecting a duck enclosure in China in a bid to prevent the spread of bird flu

THE WORLD BANK

People, Pathogens and Our Planet

Volume 1: Towards a One Health Approach for Controlling Zoonotic Diseases



REPORT NO. 50833-GLB

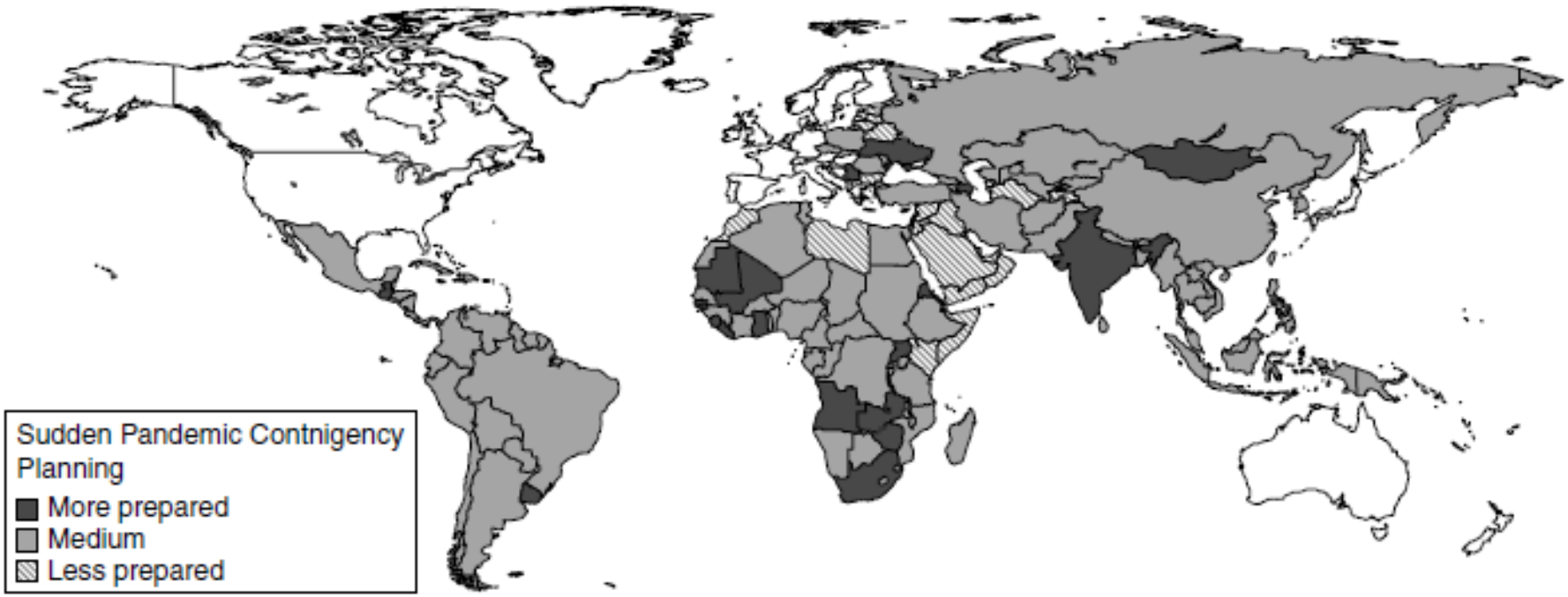
One World One Health

- **An international, interdisciplinary and cross-sectoral approach**
- **Surveillance, monitoring, prevention, control and mitigation of emerging diseases**
- **Recognizes linkages among human, animal and ecosystem health domains**
- **A framework for preventing emerging infectious diseases of animal origin (instead of simply responding to them once they have occurred)**

ONE WORLD ONE HEALTH
KEY Recommendations

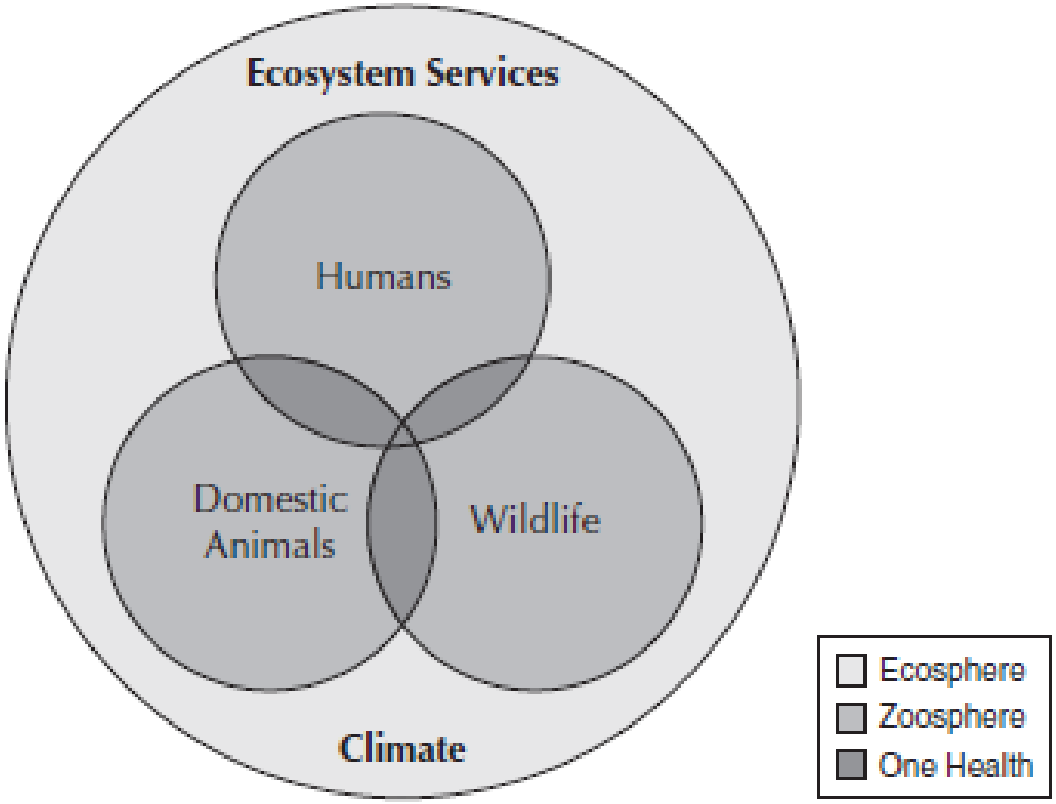
- **Foster political will**
- **Support partnership and collaboration**
- **Data sharing and integration**
- **Build capacity (infrastructure and skills)**
- **Develop communication strategies and plans**
- **Provide incentives for reporting adverse events**
- **Encourage stakeholder and community engagement**
- **Develop supra-country approaches**

UN System Pandemic Preparedness Map
Overall level of pandemic preparedness



United Nations Pandemic Influenza Contingency, Office for the Coordination of Humanitarian Affairs. (Interactive map available at http://www.un-pic.org/web/)

Interacting Health Domains



Box 3: Global Disease Information Systems

The Global Public Health Intelligence Network (GPHIN) focuses primarily on four human diseases: influenza, polio, SARS, and smallpox. The GPHIN was developed under the auspices of the WHO and is open to governments on a user fee basis. In addition to its four focal diseases, the network also monitors for certain diseases in which an outbreak would constitute "a public health emergency of international concern" (PHEIC).

The Global Outbreak Alert and Response Network is in place to follow up on any such outbreak identified by the GPHIN. It provides support to national governments on disease identification and characterization, outbreak preparedness and aid to affected populations. It is also under the auspices of the WHO.

The Program for Monitoring Emerging Diseases (ProMED)[4] is a disease reporting system of the International Society for Infectious Diseases. It is based on formal and informal sources of information. Data on human, animal, and plant diseases are collected by volunteers and screened by expert moderators. Most sources of information come from the US. Reporting by developing countries, particularly in sub-Saharan Africa, remains weak.

The Global Early Warning System for Major Animal Diseases (GLEWS) was set up to improve the tracking of diseases among animals in high-risk areas. The two zoonotic diseases it currently focuses on are HPAI and Rift Valley fever. Its principal source of data is the FAO, although it uses information from the OIE and WHO as well. It also uses a number of advanced databases such as ProMED, and the GPHIN.

The World Animal Health Information Database (WAHID) is used to store and summarize information on diseases reported to OIE.

Med-Vet-Net is a European network that maintains a database for the prevention and control of zoonoses and food-borne diseases.

The Global Emerging Infections Surveillance and Response System (GEIS) of the US Department of Defense focuses on infectious disease with a potential health risk for US military personnel.

ArboNET, the US national surveillance system for arboviral diseases, has a surveillance system for West Nile virus that can serve as an integrated system at the national level.

The Emerging Infectious Diseases Network (EIN), developed by the University of Iowa under the auspices of the US Centers for Disease Control and Prevention (CDC), is based on a network of pediatric, internist, and public health officials.

Source: Institute of Medicine and National Research Council 2008. Achieving Global Sustainable Capacity for Surveillance and Response of Emerging Diseases of Zoonotic Origin: Workshop Report. The National Academies Press. Washington, DC.

Recommendations of the WHO Review Committee on the Functioning of the 2005 International Health Regulations (IHR) in Relation to the 2009 H1N1 Influenza Pandemic

- Implementation of the core capacities
- WHO Event Information Site
- Evidence-based decisions on international travel and trade
- Authority /resources for National Focal Points
- WHO's internal capacity for sustained response
- Practices for the appointment of an emergency committee
- Pandemic preparedness guidance
- Measures to assess pandemic severity
- Management of guidance documents
- Strategic, organization-wide communications policy
- Advance agreements for vaccine distribution and delivery
- More extensive global public health reserve workforce
- Contingency fund for public health emergencies
- Agreement on the sharing of viruses, access to vaccines, and other benefits
- Comprehensive influenza research and evaluation program

Fineberg HV. N Engl J Med 2014;370:1335-1342.

Ebola Kit 1

4545 3M Coverall White 5/6 (Sizes: M / L / XL)

3M FF-402 Full Facepiece Respirator, Medium

3M 7093 Particulate Filters

3M 450 Overboots Cover

Nitrile Chemical Gloves

Ebola Kit 2

3M 4545 Coverall White 5/6 (Sizes: M / L / XL)

3M 334 Goggles (Anti-Fog)

3M H8A Headgear & 3M WP96 Face Shield

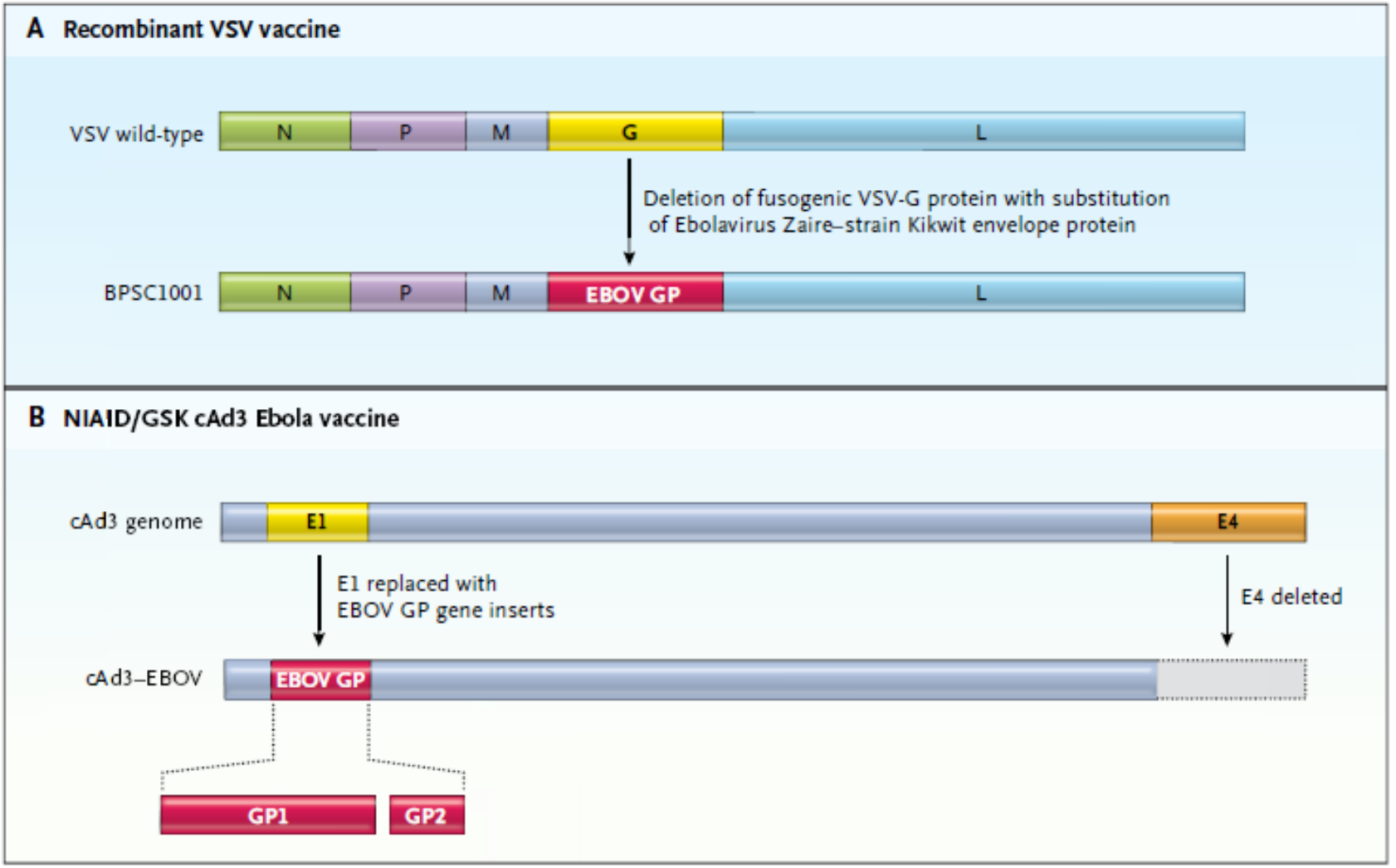
Nitrile Chemical Gloves

3M 450 Overboots Cover

3M 1860 N95 Healthcare Respirator (Sizes: Small/Regular)

Exclusively distributed by: Rebmann, Inc.

Structures of Ebola Vaccine Candidates rVSV (Panel A) and cAd3 (Panel B)



Kanapathipilla R. et al. N Engl J Med 2014

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PLOS 2013