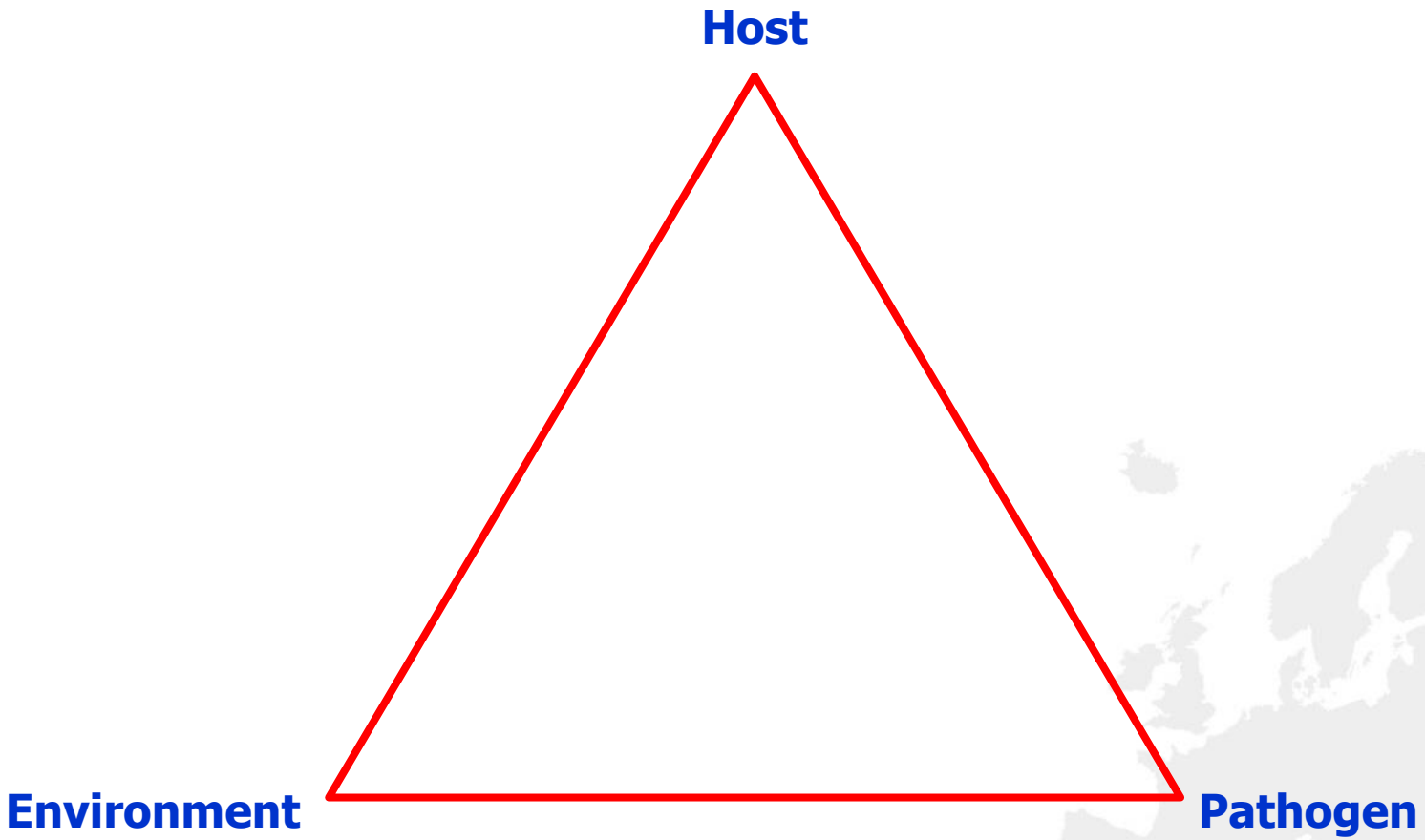
Future infectious disease health threats faced by the EU and the implications for laboratory capacity

Mike Catchpole,
Chief Scientist
European Centre for Disease Prevention and Control

Determinants of Infectious Disease Incidence



Drivers for the appearance of new threats

PERSPECTIVE

Determinants and Drivers of Infectious Disease Threat Events in Europe

Jan C. Semenza, Elisabet Lindgren, Laszlo Balkanyi, Laura Espinosa, My S. Almqvist, Pasi Penttinen, Joacim Rocklöv

Emerging Infectious Diseases •
www.cdc.gov/eid • Vol. 22, No. 4, April 2016

Determinants and drivers of infectious disease threat events, Europe, 2008–2013

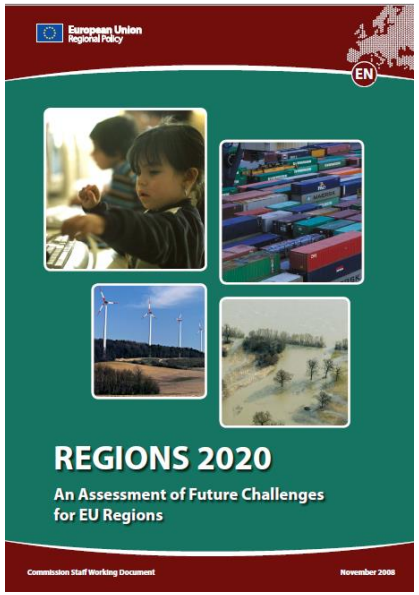
- Globalization and environment
- Socio-demographic
- Public health systems

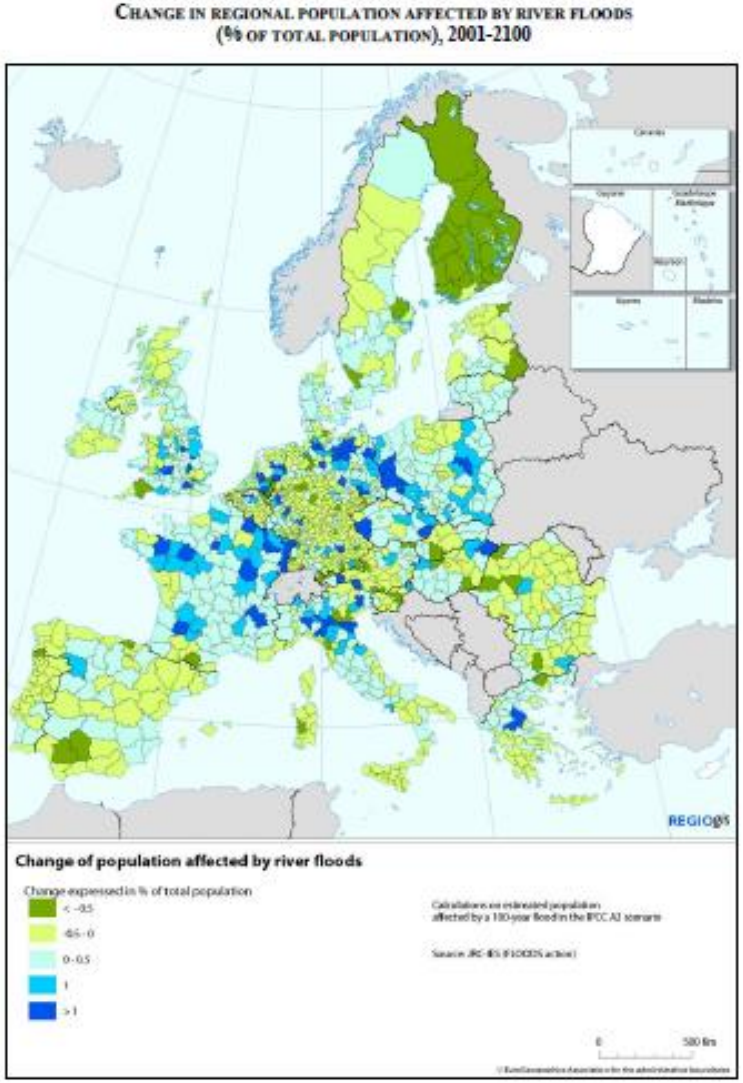
Infectious Disease Threats
determinants and drivers

Globalization and environment	
Climate	Temperature, humidity, wind, rainfall.
Natural environment	Land cover, vegetation, water ways, oceans, coastlines, water resources, land use, habitats, biodiversity.
Human-made environment	Urbanization, built environment, infrastructure, industries, intensive agriculture.
Travel and tourism	Movement of populations by automobile, train, ship, airplane.
Migration	Immigrant, emigrant, asylum seeker, settler.
Global trade	Import and export of goods and services across international boundaries via ship, airplane, rail, truck.

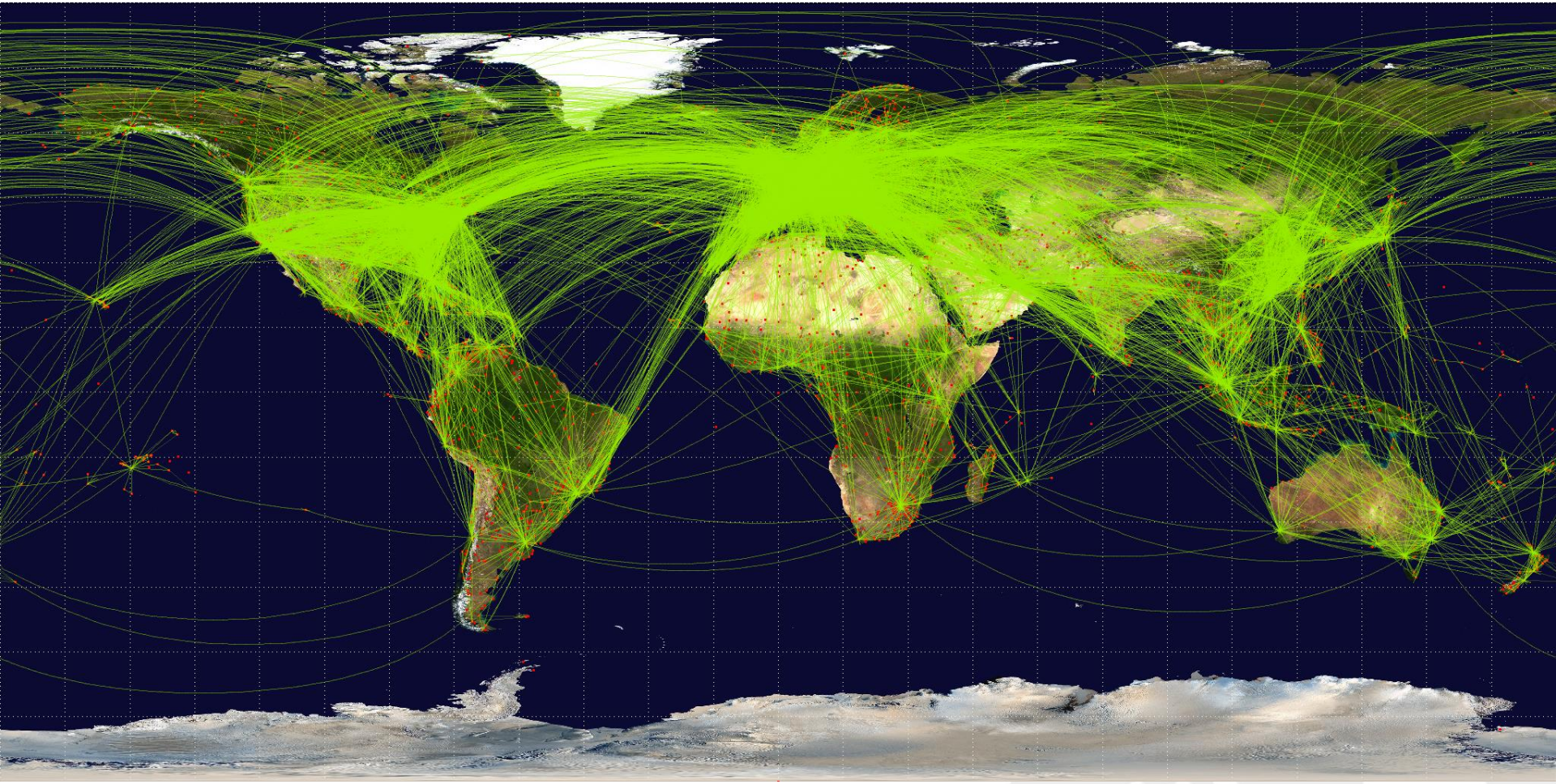
Future challenges for EU Regions: **Environmental factors**

"For climate change, there is a relatively strong core-periphery pattern, with Southern regions faring worse"

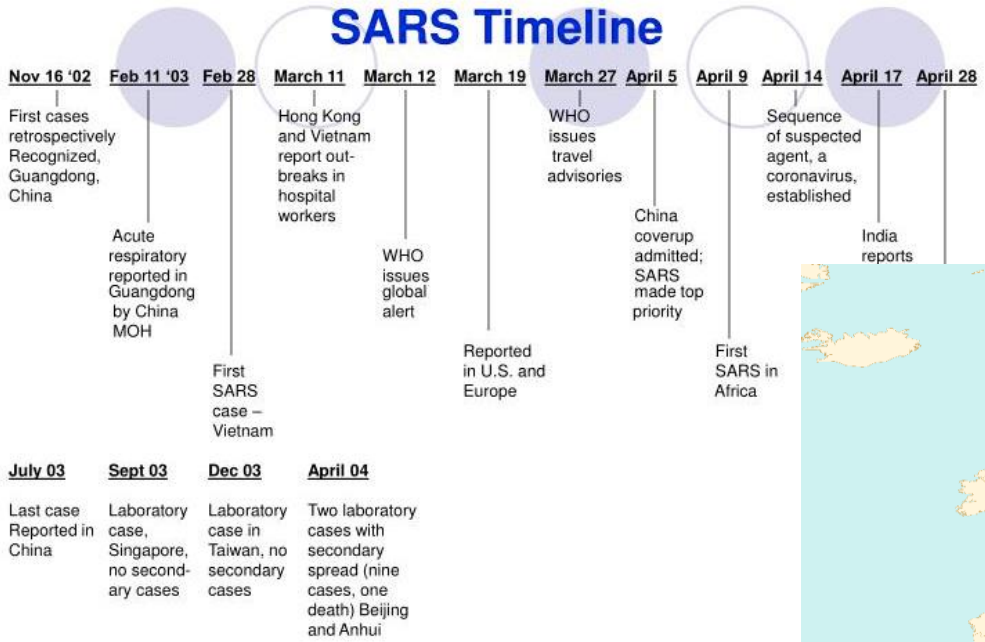




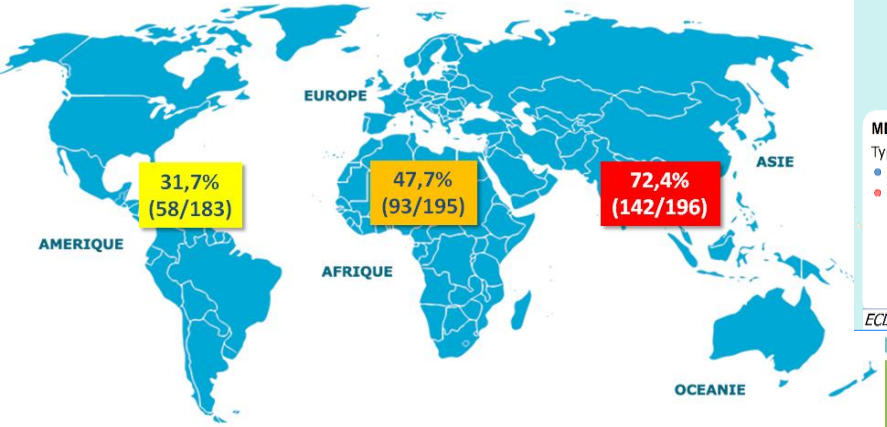
Globalisation – International Travel



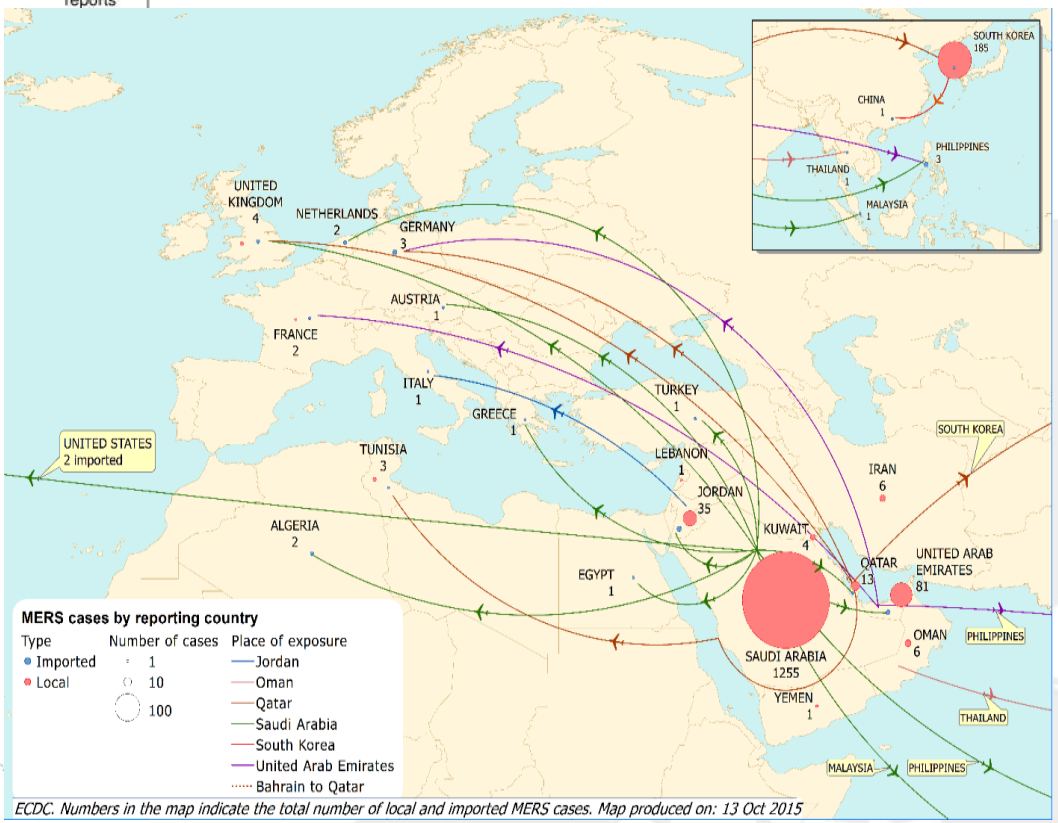
Global travel
Dissemination of infectious disease



Carriage of multidrug-resistant *Enterobacteriaceae* in returning travellers, 2012-2013



Spread of MERS CoV (2012-2015)



ECDC. Numbers in the map indicate the total number of local and imported MERS cases. Map produced on: 13 Oct 2015

Global Trade: importation of vectors

The Hidden Passenger of Lucky Bamboo: Do Imported Aedes albopictus Mosquitoes Cause Dengue Virus Transmission in the Netherlands?

Article (PDF Available) *in* Vector borne and zoonotic diseases (Larchm
20 · November 2008 *with* 179 Reads
DOI: 10.1089/vbz.2008.0071 · Source: PubMed

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28.16 · National Instit

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nus MC, Rotterdam, The Neth...

Show more authors

Abstra

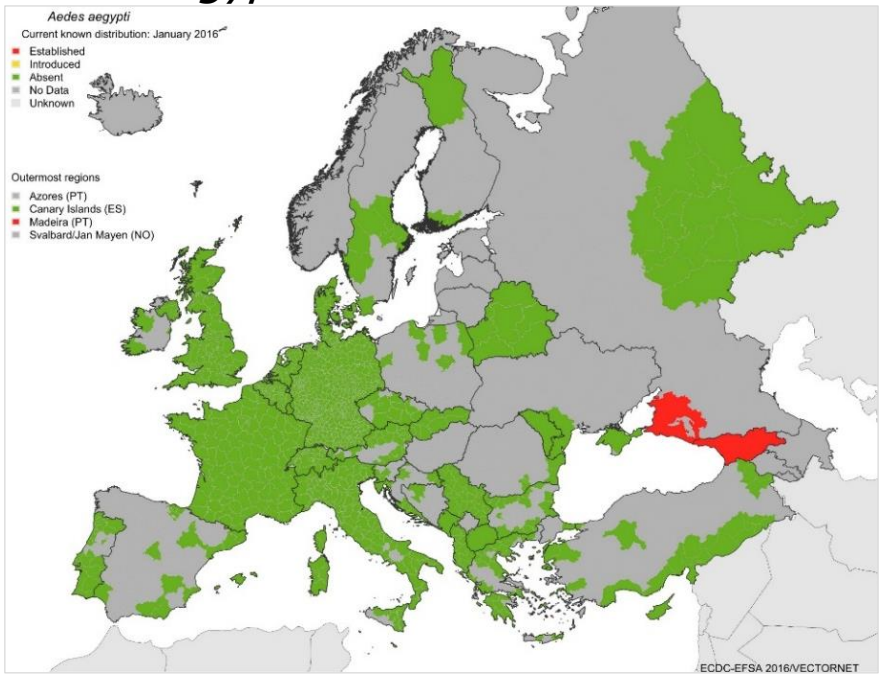
Since 2005, albopictus mosquitoes have been detected in companies in the Netherlands that import ornamental plants from China. To assess the risks of dengue transmission, a study was carried out in 48 persons who are professionally exposed to these mosquitoes. No evidence for non-travel-related flavivirus infections was found.

vigilance is needed, because establishment of a potential arbovirus vector of a series of human arboviruses may lead to new infectious disease outbreaks

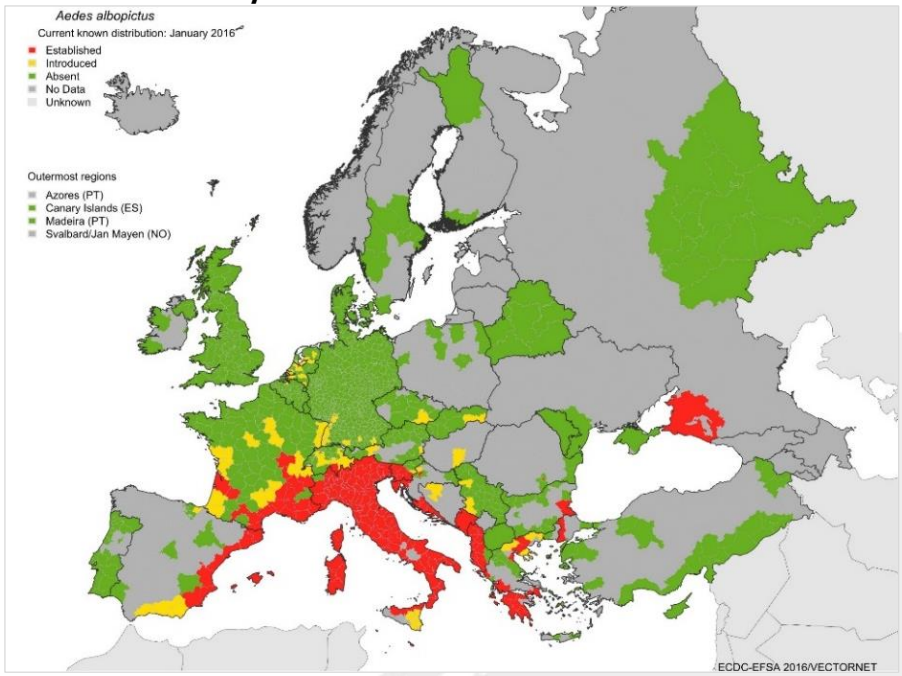
Aedes mosquitoes in Europe

Aedes mosquitoes distribution as of January 2016

Aedes aegypti



Aedes albopictus



Established Introduced Absent No data/unknown

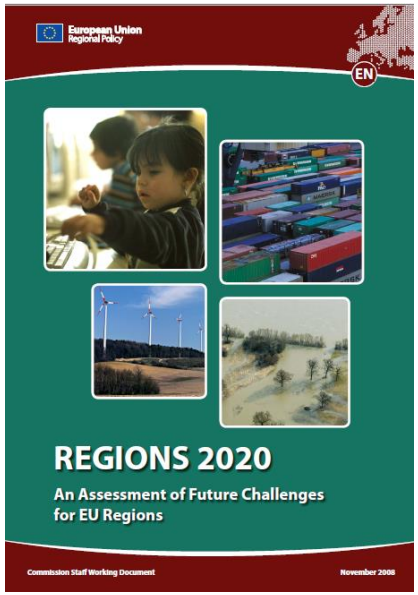
Map updates available from:
http://ecdc.europa.eu/en/activities/diseaseprogrammes/emerging_and_vector_borne_diseases/Pages/VBORNET.aspx

Infectious Disease Threats
determinants and drivers

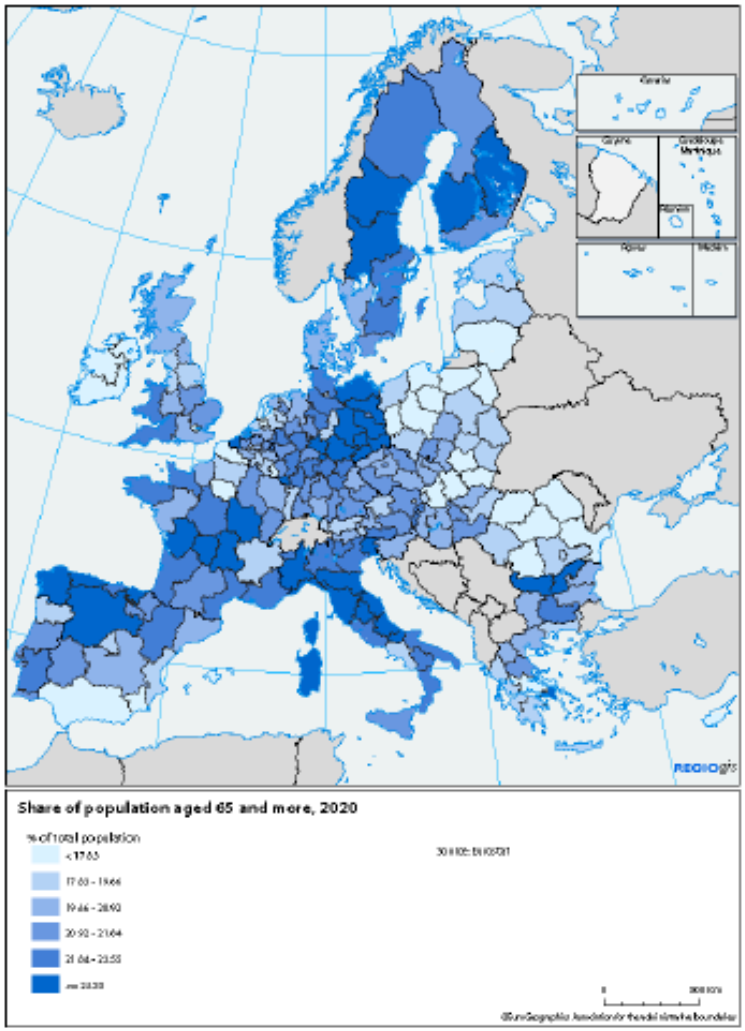
Socio-demographic	
Demographic	Population composition with regards to age, income, education.
Social inequality	Uneven distribution of resources in society, including income, wealth, rights, privileges, social power, education.
Vulnerable groups	Children, premature infants, pregnant women, elderly persons, men who have sex with men, immunocompromised persons.
Prevention	Childhood vaccination programs, adherence to treatment regimes, appropriate prescription practices.
Lifestyle	High-risk behaviour, such as intravenous drug use or unprotected sex with multiple partners.
Occupational	Healthcare workers, veterinary and animal care personnel, butchers, farmers, cleaners.
Terrorism	Intentional release or dissemination of biologic agents.

Future challenges for EU Regions: **Demographic factors**

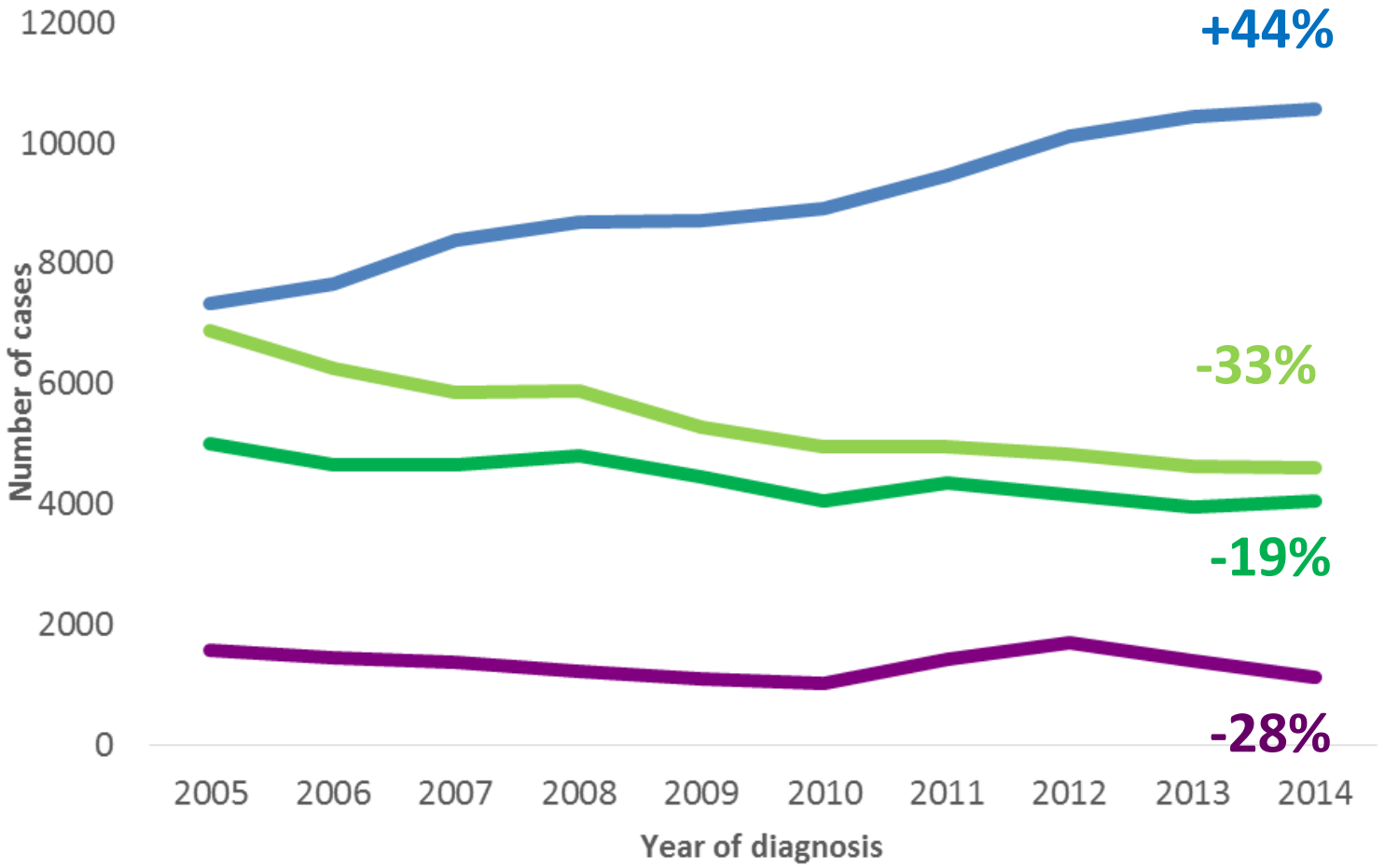
"For demographic change, there is significant variation across European regions, once again with slightly greater vulnerability in South and South Eastern regions"



REGIONAL SHARE OF PEOPLE AGED 65 AND ABOVE IN 2020 (% OF TOTAL POPULATION)



HIV diagnoses, by mode of transmission, 2005-2014, EU/EEA



Sex between men

Heterosexual contact (women)

Heterosexual contact (men)

Injecting drug use

Data is adjusted for reporting delay. Cases from Estonia and Poland excluded due to incomplete reporting on transmission mode during the period; cases from Italy and Spain excluded due to increasing national coverage over the period.

Source: ECDC/WHO (2015). HIV/AIDS Surveillance in Europe, 2014

“Do-it-yourself” gene engineering **Bedroom bioterrorism?**

RAPID RISK ASSESSMENT

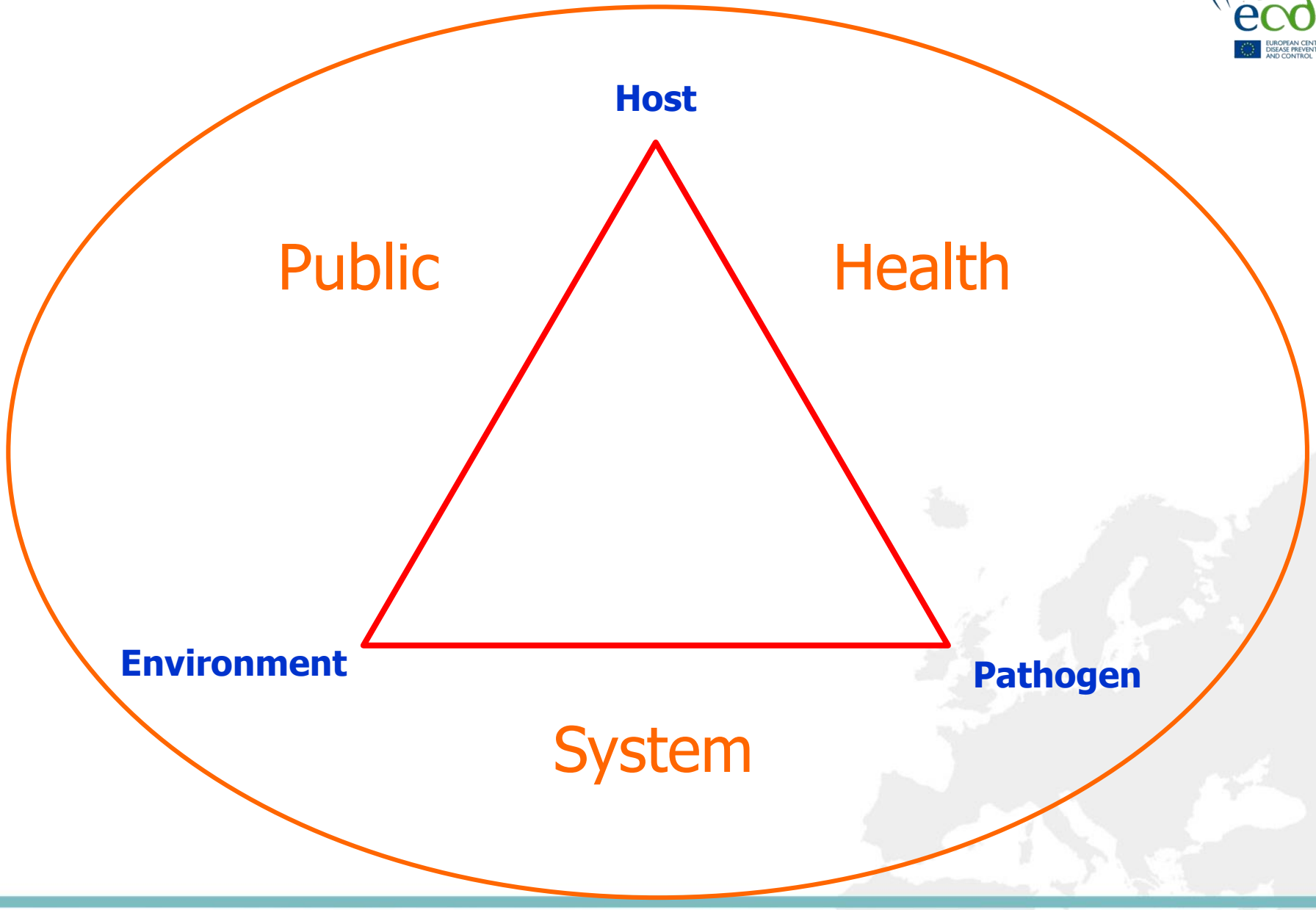
Risk related to the use of ‘do-it-yourself’ CRISPR-associated gene engineering kit contaminated with pathogenic bacteria

2 May 2017

Conclusions

On 24 March 2017, the German authorities reported the contamination of a ‘do-it-yourself’ bacterial gene engineering CRISPR kit produced in the US. The kit was contaminated with pathogenic bacteria (risk group 2), including some bacteria that are multidrug-resistant and ESBL-producing. The kits are still sold online and target

Determinants of Infectious Disease Incidence

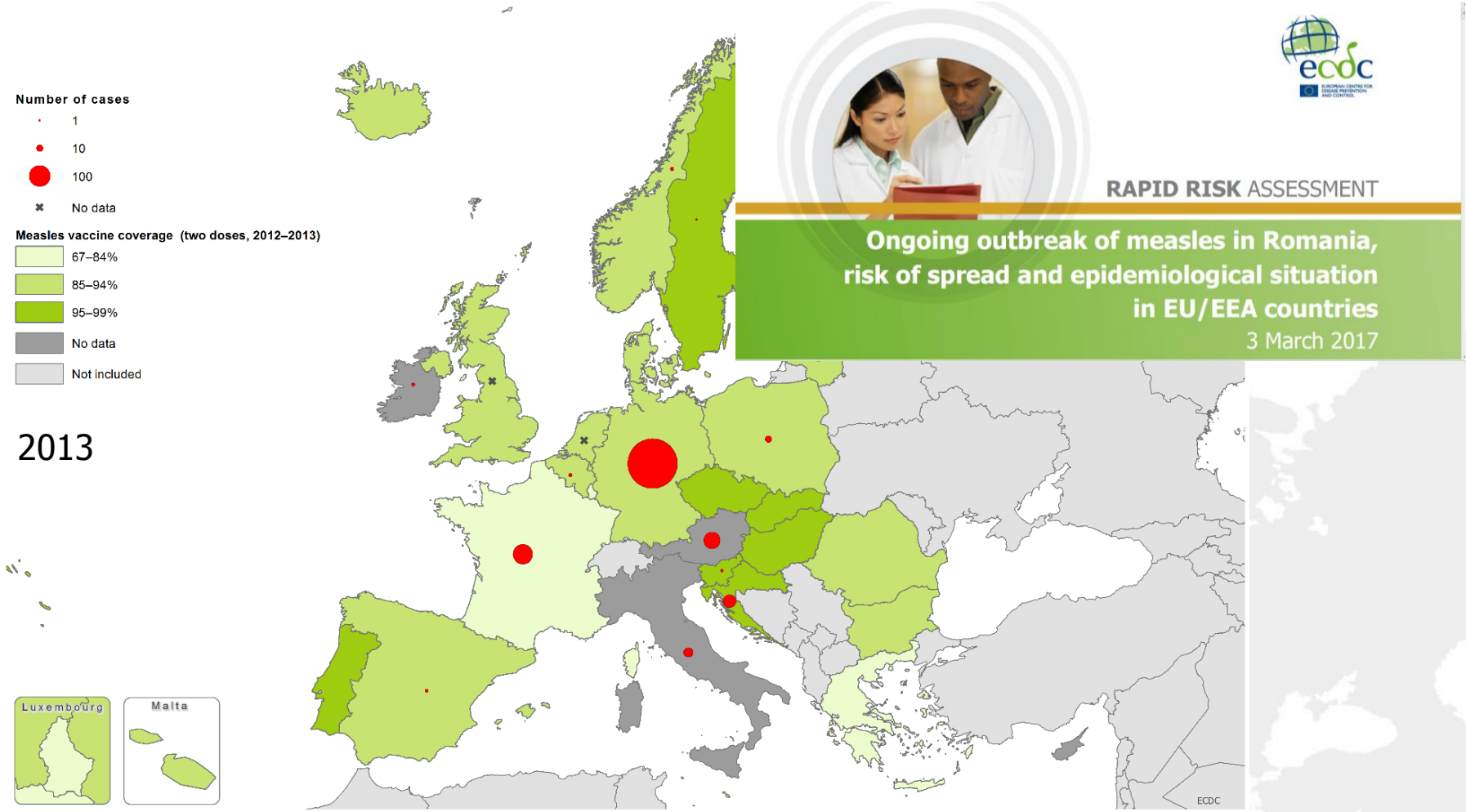


Infectious Disease Threats
determinants and drivers

Public health systems	
Healthcare system	European healthcare structure for the delivery of health services, including general practitioners, hospitals, clinics.
Animal Health	Veterinary services, animal health and welfare measures, intensive livestock practices.
Food and water quality	Agriculture, husbandry, farming, processing, handling, preparation and storage of food, manmade water systems, water treatment and distribution systems.
Surveillance and diagnostic capacity failure	Systematic ongoing collection, collation, analysis, and dissemination of infectious disease data.

Vaccination policy in Europe is <u>not</u> achieving its public health goals

elimination of measles in Europe by ~~2010~~, ~~2015~~, 2020 (?!)



Source: TESSy data on measles cases reported **<u>1 January – 30 April 2015</u>**;
Measles vaccine coverage (two doses, 2012 – 2013)

Health Service Infrastructure & Resources
Vaccine supply

RAPID RISK ASSESSMENT

Shortage of acellular pertussis-containing vaccines and impact on immunisation programmes in the EU/EEA (first update)

2 February 2016

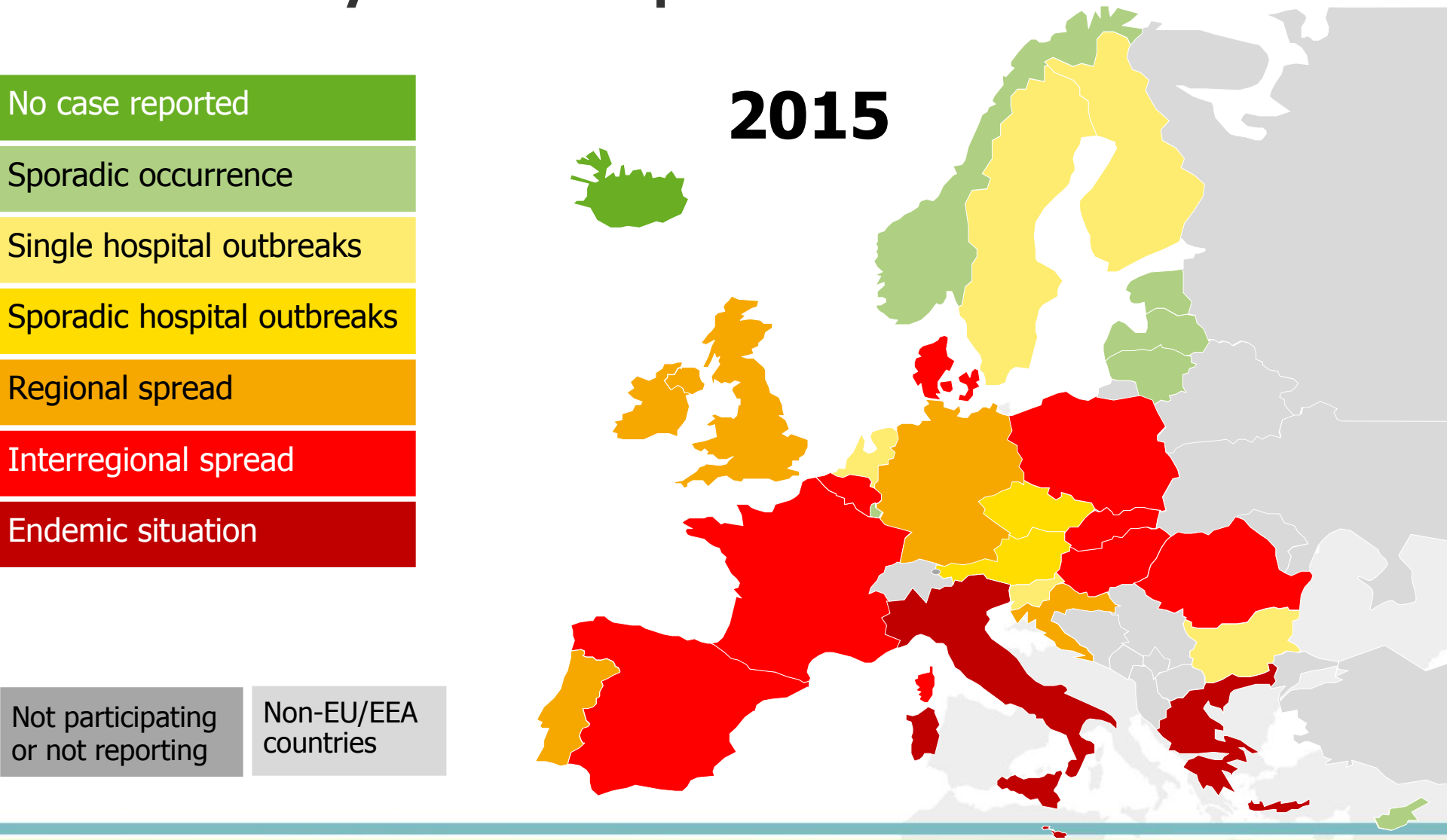
Main conclusions and options for response

The vaccine shortage currently affecting some EU/EEA Member States has already had direct consequences for the delivery of national vaccination programmes.

In general, the supply situation appears similar to what was previously reported, and uncertainty prevails. Some countries had to make short-term arrangements with other countries to avoid interruption of their programmes.

Since 2015, nine EU/EEA Member States have adjusted their immunisation policies. Measures included the following:

Spread of carbapenemase-producing *Enterobacteriaceae* (CPE) in the EU/EEA: assessment by national experts

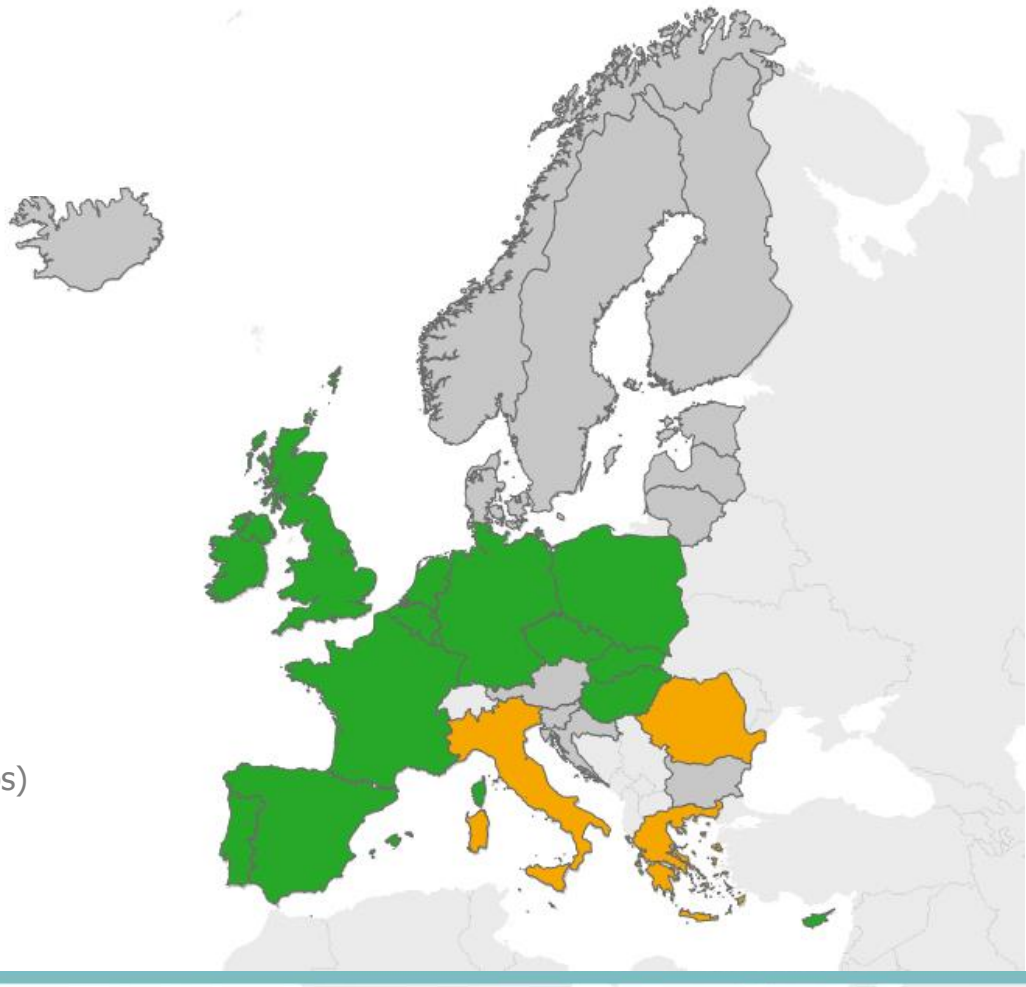


Source: Albiger B, et al. Eurosurveillance 2015; 20(45) (12 November 2015)

Klebsiella pneumoniae
percentage of invasive isolates with resistance to all antibiotic groups under surveillance*, EU/EEA, 2013

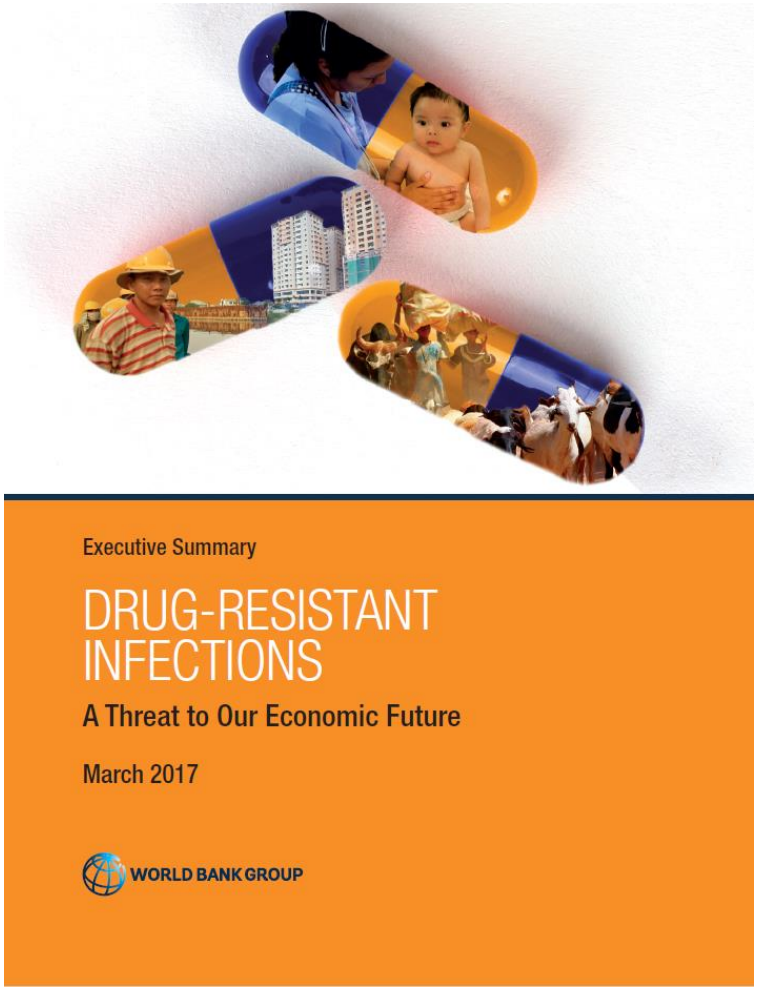
*Third-generation cephalosporins, fluoroquinolones, aminoglycosides, carbapenems and colistin

Only among isolates that were tested for susceptibility to all these antibiotic groups were included.



Source: EARS-Net, 2014

Antimicrobial Resistance
The wider implications



The annual reduction in global GDP caused by AMR could be as large as the losses provoked by the 2008 global financial crisis. However, the cost impacts of AMR on GDP would be worse than those of the financial crisis in two respects. First, they would be felt throughout the period to 2050, not just for a couple of very bad years. Second, with AMR, low-income countries would experience larger drops in economic growth than wealthy countries, so global poverty and economic inequality would increase

Emerging zoonoses – what next?

Table 1. **Examples of novel, emergent zoonotic virus diseases**

Year of isolation	Place of isolation	Virus	Reservoir/spillover host
1991	Venezuela	Guanarito virus[20]	Rodents
1992	Slovenia	Dobrava virus[21]	Rodents
1993	United States	Sin Nombre virus[22]	Rodents (*Peromyscus maniculatus*)
1994	Brisbane, Australia	Hendra virus[23]	Fruit bats (*Pteropus sp.*)/horses*
	Sao Paolo, Brazil	Sabia virus[24]	Rodents
1995	Florida, USA	Black Creek Canal virus[25]	Rodents
1996	Ballina, Australia	Australian bat lyssavirus[26]	Fruit and insectivorous bats
	Argentina	Andes virus[27]	Rodents
1997	Hong Kong (China)	Influenza H5N1[28]	Wild birds/domestic poultry*
	Menangle, Australia	Menangle virus[29]	Fruit bats
	Saudi Arabia	Alkhurma virus[30,31]	Camels and sheep†
1999	Peninsular Malaysia	Nipah virus[32,33]	Fruit bats/pigs*
			s
			ts?*
			s/domestic poultry*
			?
			s?
			s?/various animals (bush meat)*
			ied rodents
			s?

efsa European Food Safety Authority

ecdc EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL

EFSA Journal 2011; 9(1):1945

SCIENTIFIC OPINION

Joint Scientific Opinion on any possible epidemiological or molecular association between TSEs in animals and humans[1]

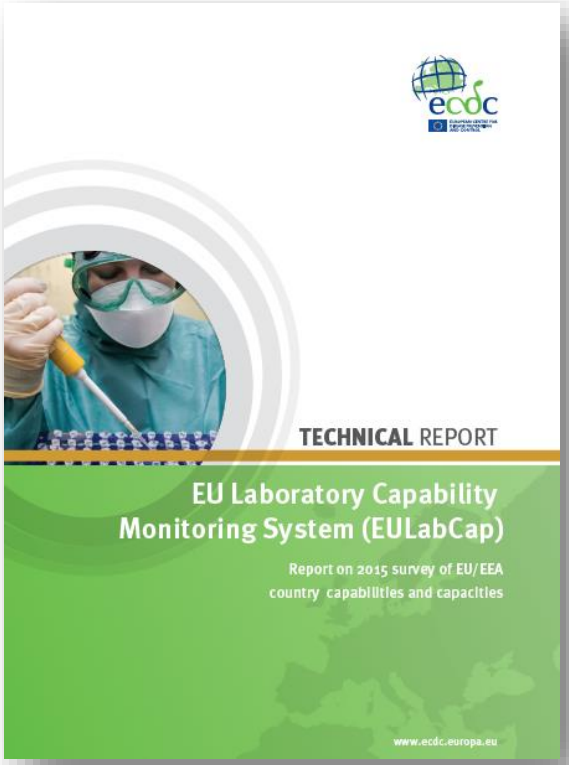
EFSA Panel on Biological Hazards (BIOHAZ)[2, 3]

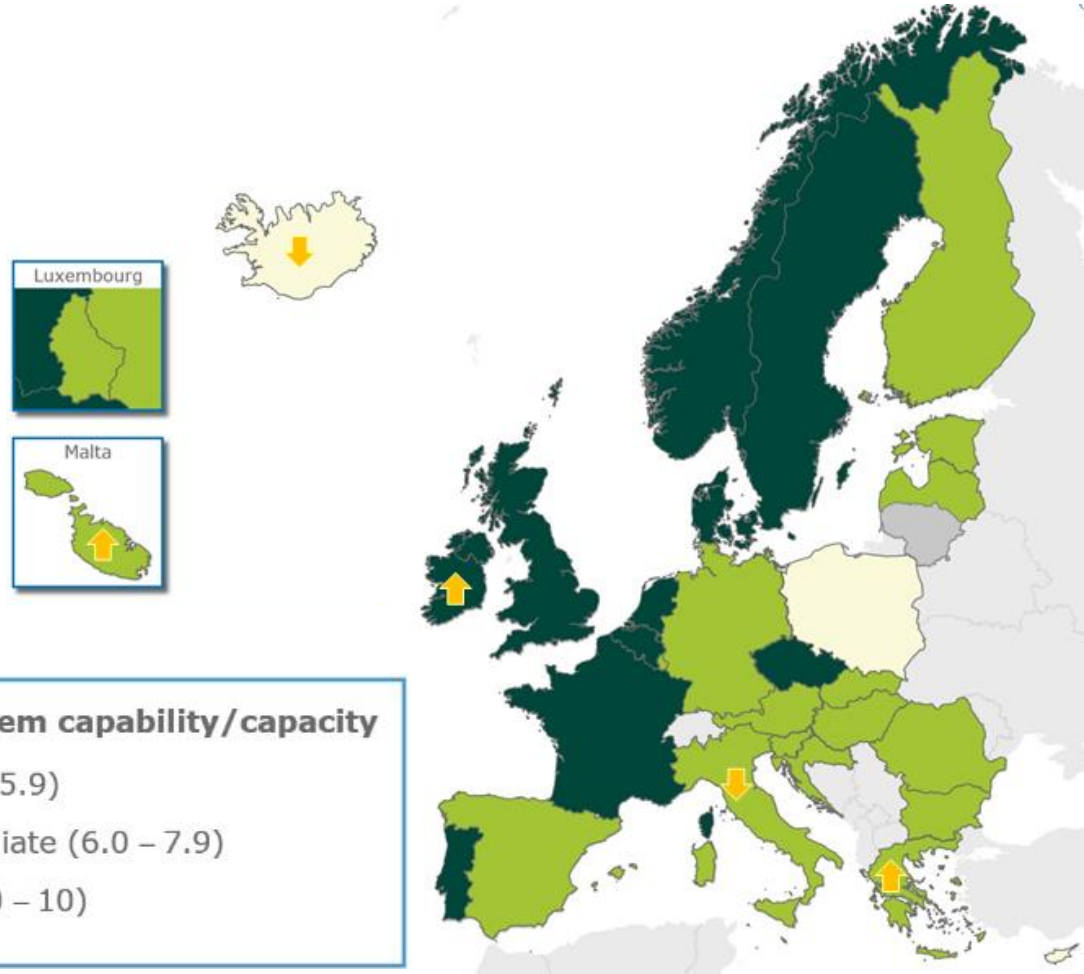
European Food Safety Authority (EFSA), Parma, Italy

European Centre for Disease Prevention and Control (ECDC)[4, 5]

Stockholm, Sweden

Level of microbiology capabilities by country
(N=29 EU/EEA countries, 2015)

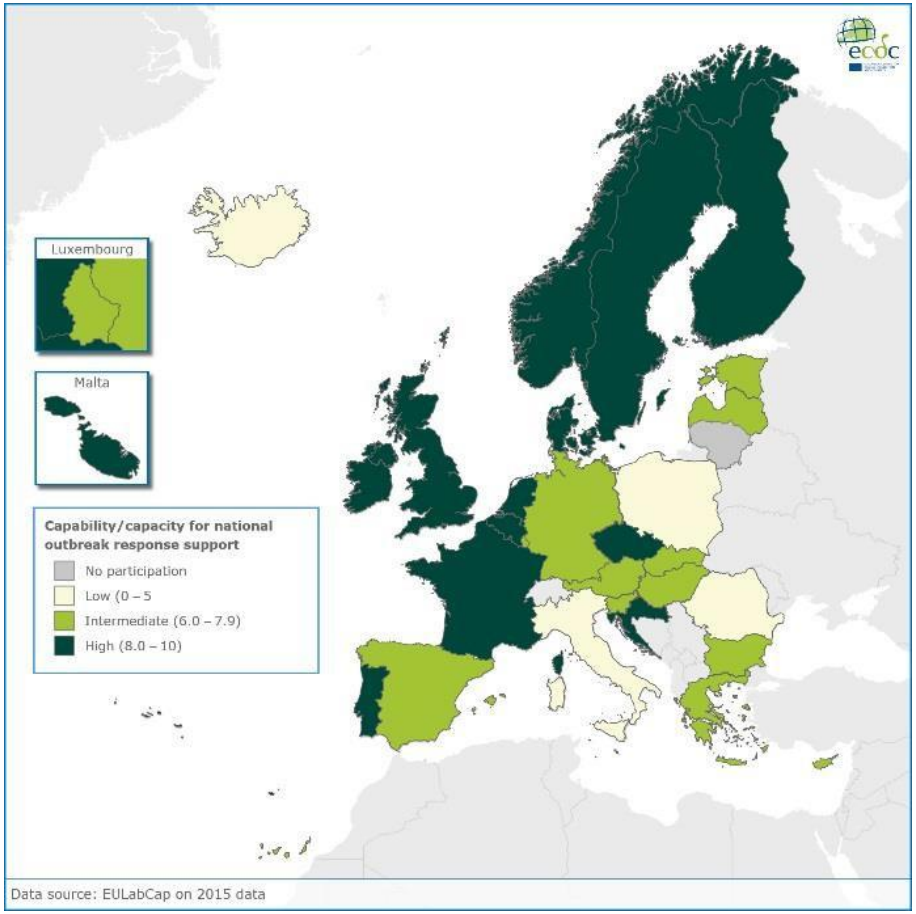




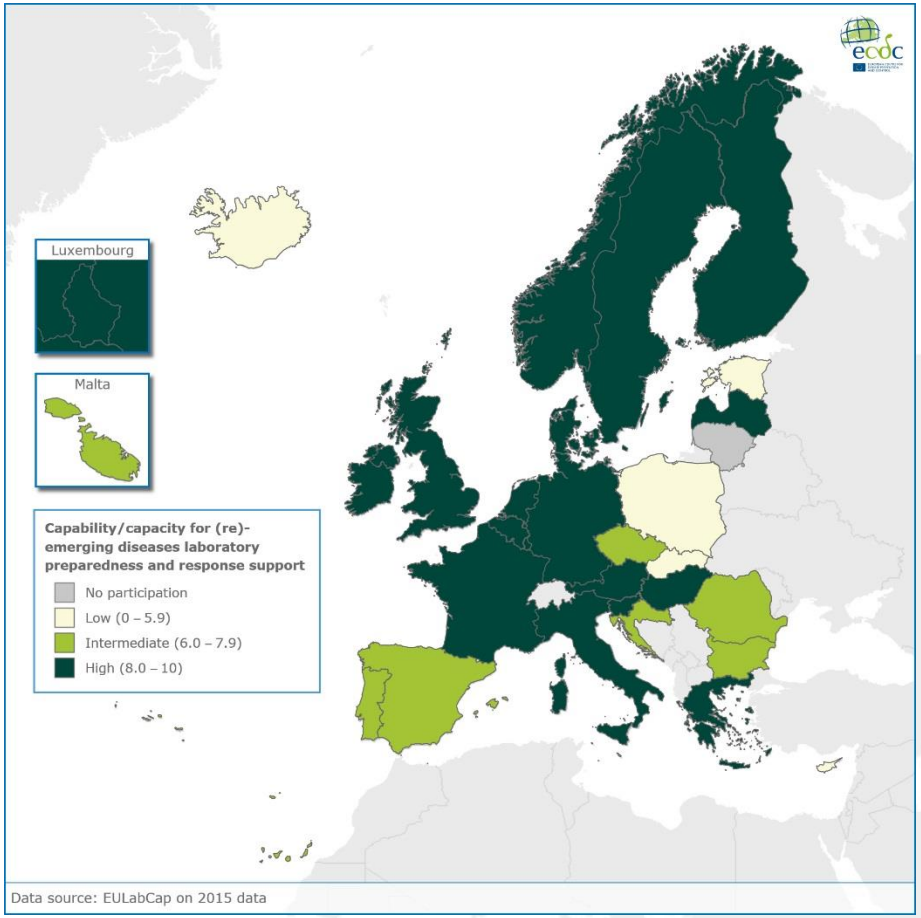
Source: European Centre for Disease Prevention and Control. European Centre for Disease Prevention and Control. EU Laboratory Capability Monitoring System (EULabCap) – Report on 2015 survey of EU/EEA country capabilities and capacities. Stockholm: ECDC; 2017.

Level of target capabilities by country
(N=29 EU/EEA countries, 2015)

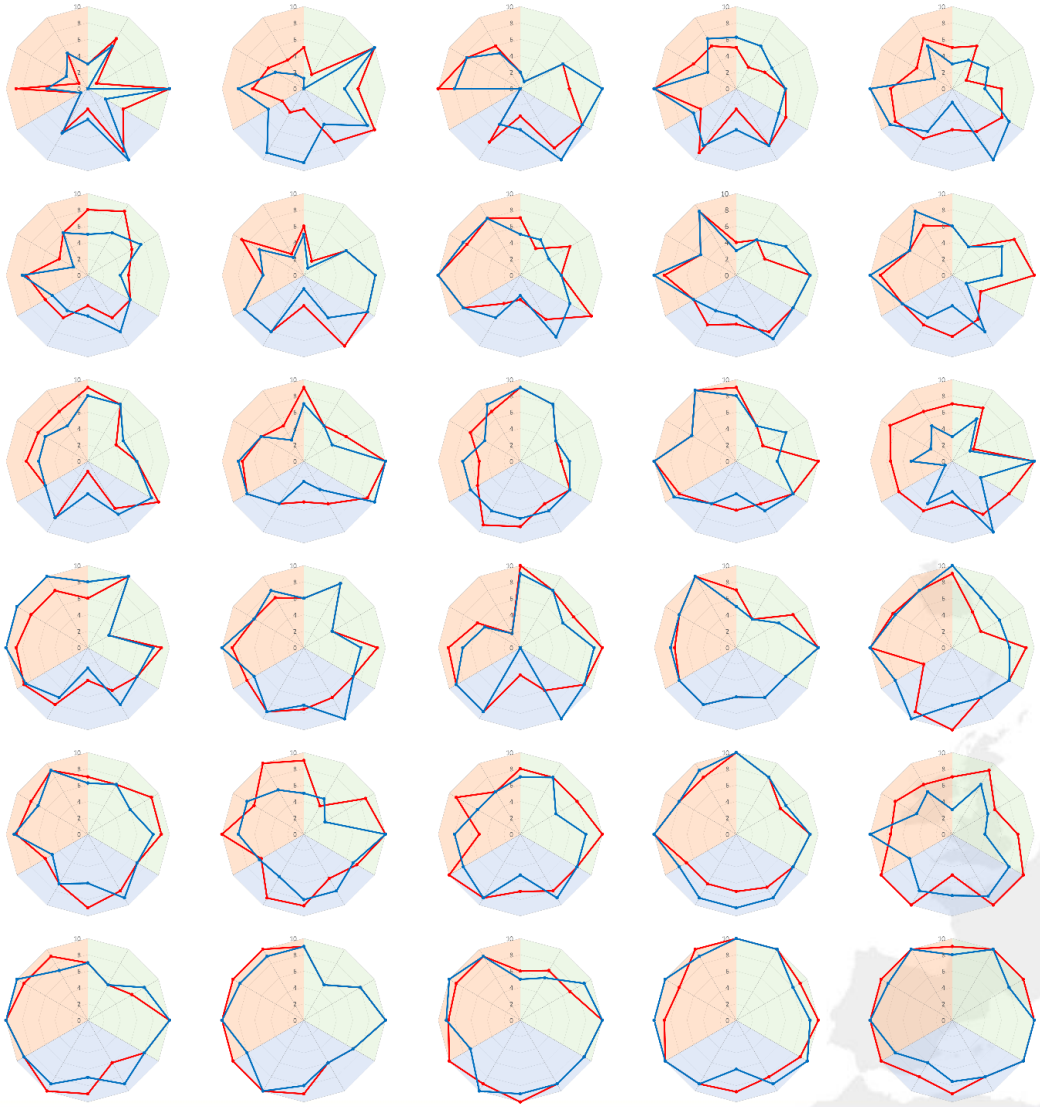
Target 3.3 National outbreak response support



Target 3.4 Capability for (re-)emerging diseases preparedness



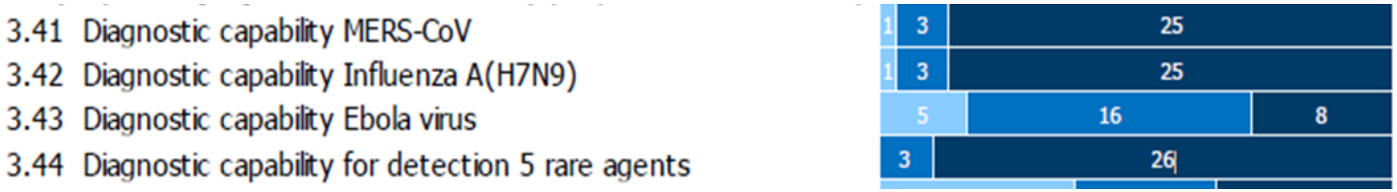
Radar graphs for target indices, (30 EU/EEA countries), 2013 (blue) and 2014 (red)



Emerging viral pathogen detection capabilities in the EU/EEA

Figure 13. EU/EEA distribution of 2015 results by country for the 20 EULabCap indicators on laboratory-based surveillance and epidemic response support and mean scores, 2013–2015

Target 3.4 (Re)-emerging diseases laboratory preparedness and response support

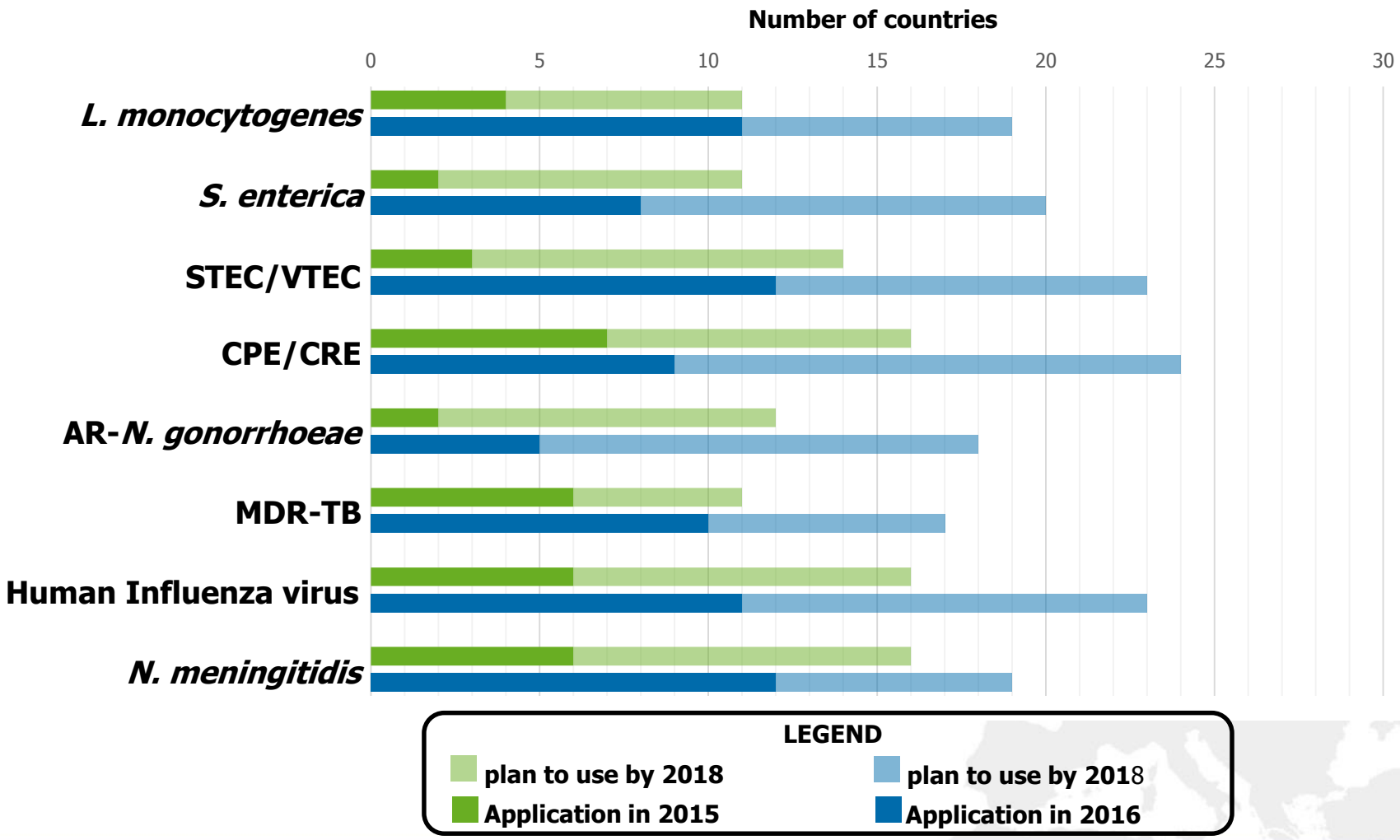


8.0	8.7	9.1
9.0	9.2	9.1
5.0	5.2	5.5
8.6	9.5	9.5

Indicator 3.44 Diagnostic capability for detection 5 rare agents

One or more reference virology laboratories in your country have detection capability for the following 5 rare AND/OR imported viruses: Chikungunya/Dengue/Hantavirus/Tick borne encephalitis/West Nile.

WGS application in EU/EEA countries for National Surveillance



Source: NMFP surveys 2015 (n=28 respondents) and 2016 (n=29 respondents)

What are the biggest threats (a personal view)

Predictability	Threat
Known Knowns	AMR, vaccine hesitancy
Known Unknowns	
Unknown Knowns	
Unknown Unknowns	

What are the biggest threats (a personal view)

Predictability	Threat
Known Knowns	AMR, vaccine hesitancy
Known Unknowns	Pandemic influenza
Unknown Knowns	
Unknown Unknowns	

What are the biggest threats (a personal view)

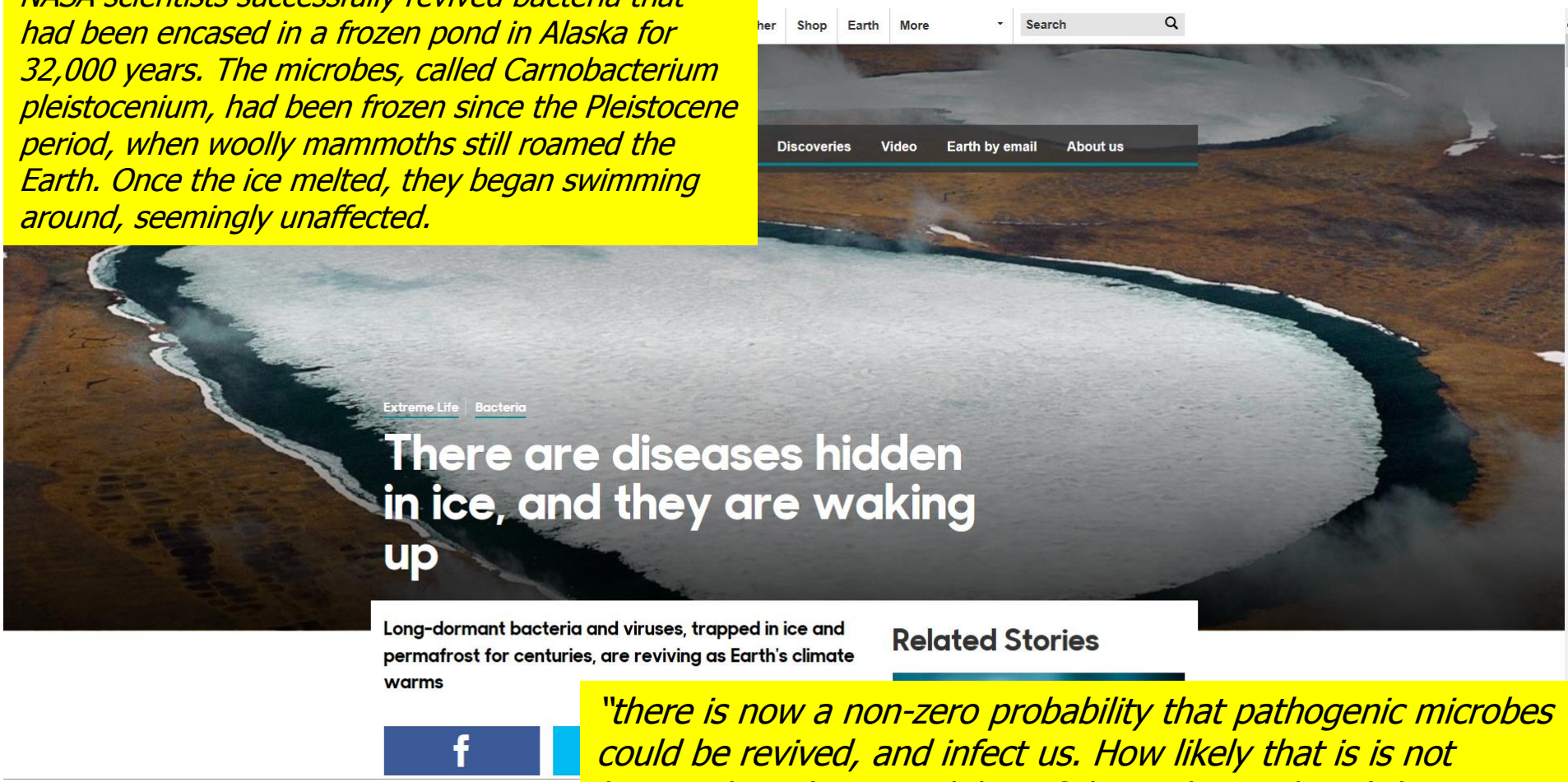
Predictability	Threat
Known Knowns	AMR, vaccine hesitancy
Known Unknowns	Pandemic influenza
Unknown Knowns	Zoonoses, vector-borne disease (e.g. Zika)
Unknown Unknowns	

What are the biggest threats (a personal view)

Predictability	Threat
Known Knowns	AMR, vaccine hesitancy
Known Unknowns	Pandemic influenza
Unknown Knowns	Zoonoses, vector-borne disease (e.g. Zika)
Unknown Unknowns	

Climate change – hidden threats?

NASA scientists successfully revived bacteria that had been encased in a frozen pond in Alaska for 32,000 years. The microbes, called Carnobacterium pleistocenium, had been frozen since the Pleistocene period, when woolly mammoths still roamed the Earth. Once the ice melted, they began swimming around, seemingly unaffected.



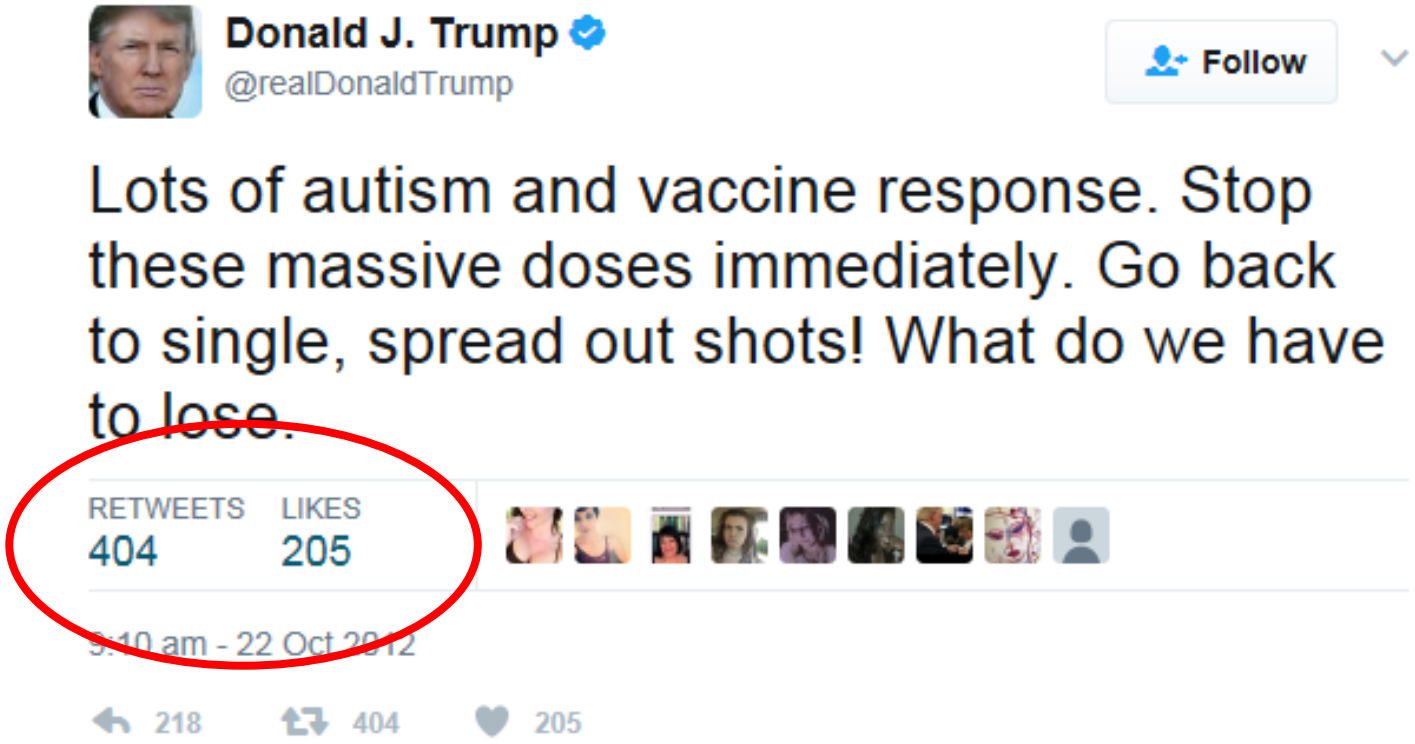
"there is now a non-zero probability that pathogenic microbes could be revived, and infect us. How likely that is is not known, but it's a possibility. If the pathogen hasn't been in contact with humans for a long time, then our immune system would not be prepared"

Infectious Disease Threats
determinants and drivers

Information technology

The new driver for 21st century epidemics?

Scientific Scepticism & the "Post Factual" Age



Scientific Scepticism & the "Post Factual" Age

Andrew Wakefield

Lancet retracts 'utterly false' MMR paper

After medical council ruling last week that MMR doctor Andrew Wakefield was dishonest, journal finally quashes paper

The Lancet today finally retracted the paper that sparked a crisis in MMR vaccination across the UK, following the General Medical Council's decision that its lead author, Andrew Wakefield, had been dishonest.

The medical journal's editor, Richard Horton, told the Guardian today that he realised as soon as he read the GMC findings that the paper, published in February 1998, had to be retracted. "It was utterly clear, without any ambiguity at all, that the statements in the paper were utterly false," he said. "I feel I was deceived."

The Guardian: Tuesday 2 February 2010

The impact of scientific misinformation

UK Public Opinion on MMR Safety 2001-2003

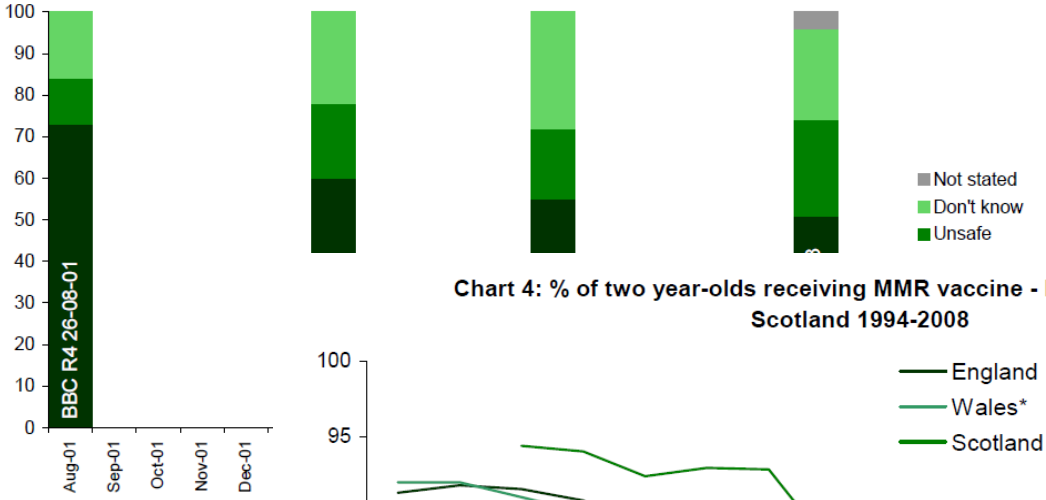
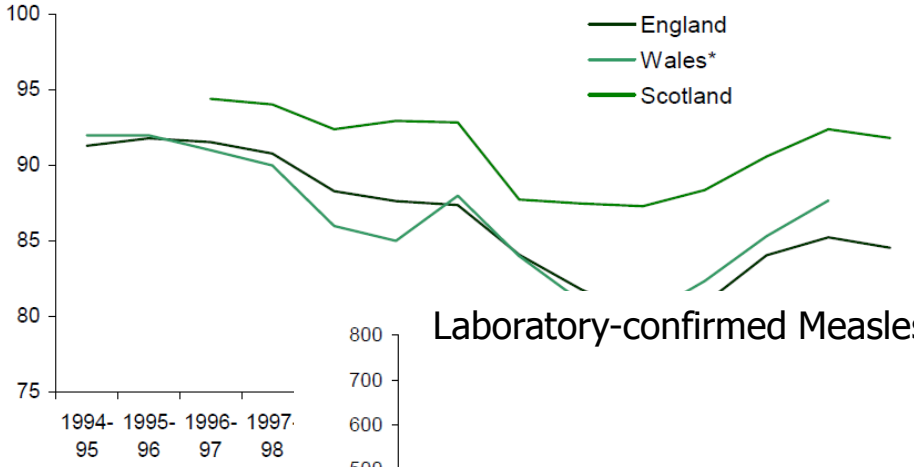
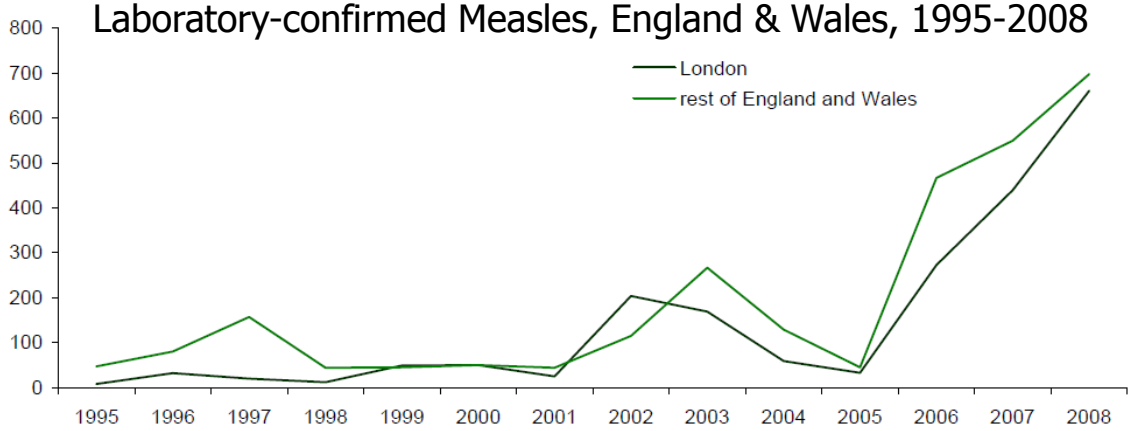


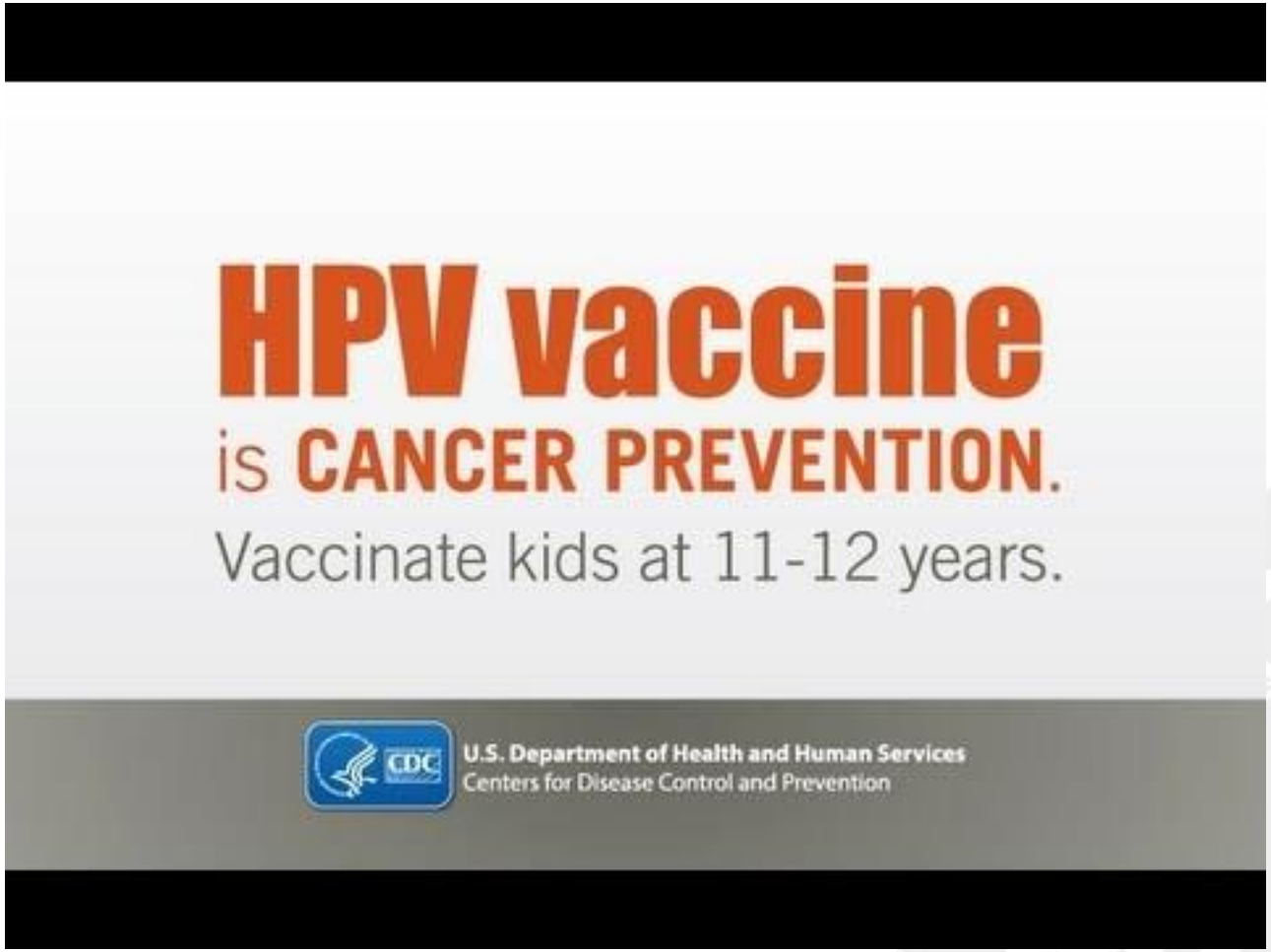
Chart 4: % of two year-olds receiving MMR vaccine - England, Wales and Scotland 1994-2008



Laboratory-confirmed Measles, England & Wales, 1995-2008

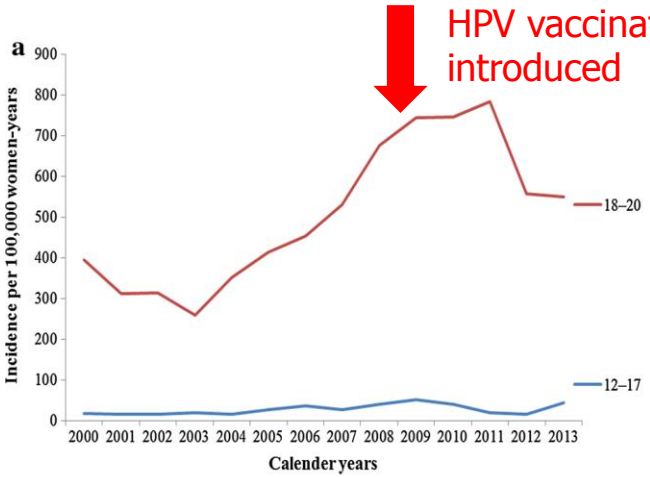


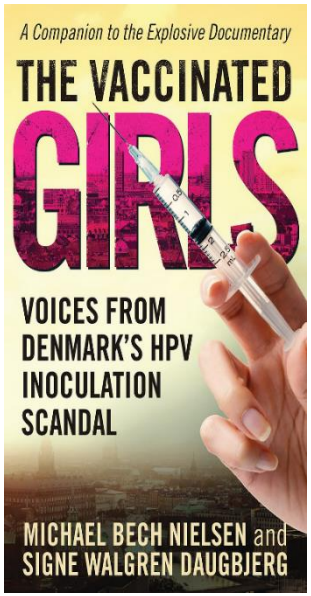
But what if we had a vaccine against cancer?



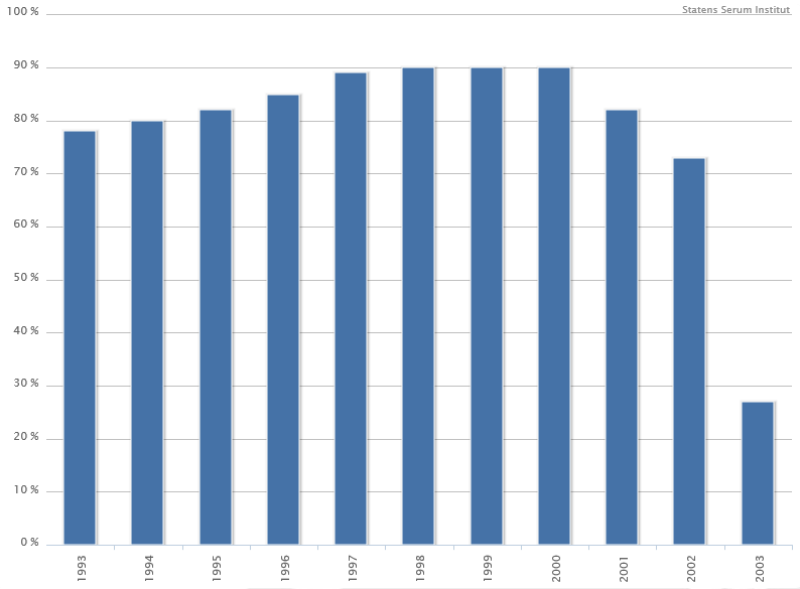
HPV Vaccination in Denmark

Incidence of cervical lesions (CIN2+)





Uptake of first HPV vaccine by year of birth, females, 1993-2003



Health Service Infrastructure & Resources
e-Health: benefits and risks

NHS trust cancels operations after computer virus hits IT system

North Lincolnshire and Goole trust shuts down most of its network and cancels appointments and routine surgery at three hospitals

Emergency cases are being redirected to neighbouring hospitals. Photograph: Christopher Furlong/Getty Images

All appointments and routine operations have been cancelled at three hospitals after a computer virus attacked critical systems.

Officials said around 1,000 patients would be affected at hospitals run by the North Lincolnshire and Goole trust after a major incident was declared due to the virus, which was identified on Sunday.

What is your preparedness plan for when your national microbiology systems are knocked out by hackers?

Acknowledgements

Svetla Tsolova

Kåre Mølbak

Marc Struelens

ECDC Disease Programme Teams

- Antimicrobial Resistance and Healthcare Associated Infections
- Emerging and Vectorborne Diseases
- Food and Waterborne Diseases
- Influenza and Respiratory Viruses
- HIV Sexually Transmitted Infections and Hepatitis
- Tuberculosis
- Vaccine Preventable Diseases

Thank you!