Biosecurity and Microbial Collections

Joost Stalpers

CBS-KNAW Fungal Biodiversity Centre, Utrecht

Biological warfare: history -1945

- Romans: used dead animals to foul enemy water supplies (botulism)
- Medieval: Tartars used catapults to throw bodies of plague victims over wall into city of Kaffa
- 1500s: Aztecs conquered by Spanish explorers (Diego Velasquez, Hernan Cortes), carrying measles/ chickenpox/ smallpox/ etc.
- 1700s: Smallpox in blankets given to native Indians, by British army during the French & Indian war (1754-1763)
- 1918-42: Japanese army Unit 731, used plague on China, via spraying from planes, bombs and releasing rats
- 1943: British bioweapons testing using anthrax on Gruinard Island, off the Scottish coast. Backfired when the mainland was also contaminated with anthrax spores.
- 1942-1969: US bioweapons program based at Fort Detrick, Ma: showed in 1966 that release of *Bacillus subtilis* at one subway station could infect the whole system

Biological warfare: history >1945

- 1972: Biological Weapons and Toxin Convention
- 1972: Yugoslavia, smallpox outbreak, 175 cases, 35 deaths
- 1973-74: Russian Biopreparat biological weapons R & D program (Novosibirsk)
- 1979: Accidental release of inhalation anthrax (spores) from bioweapons plant in Sverdlovsk, USSR - 66 deaths
- 1984: Rajneeshee, *Salmonella typhimurium* food poisoning of salad bars, The Dalles and Wasco County, Oregon - to incapacitate voters to win local election
- 1988-90: Iraqi Al-hakam Factory, producing anthrax, botulinum toxin. Viruses added in 1990.
- 1990-95: Aum Shinrikyo: Ebola expedition to Zaire; botulinum toxin and anthrax tested around Tokyo (failed attempts); sarin nerve gas attack, in Tokyo, on 5 converging trains: 3800 affected, 1000 hospitalised, 12 dead - to attack national police/ ministries
- 2004: Antonina Prenyakova (Vector labs, Russia) died after sting incident while experimenting with Ebola

Biosecurity: classification

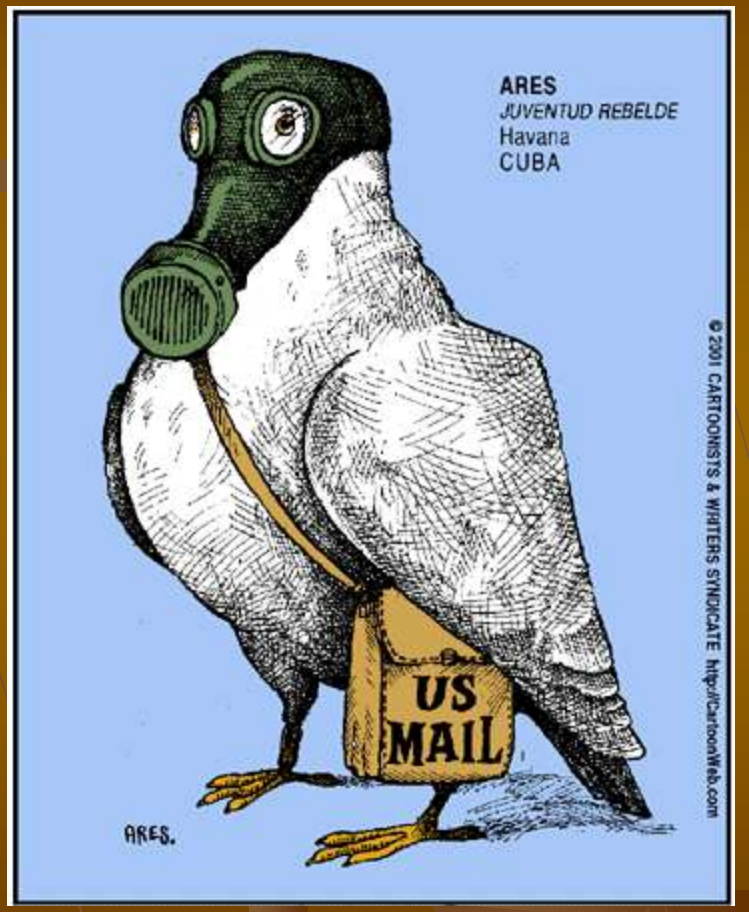
- **Biowarfare:** military conflict between nations: Iraq against Kurds
  – short to long term goals
- **Bioterrorism:** religion/ political/ ideological/ environmental groups attacking civilians: Aum Shinrikyo, metro attacks
  – short term goals
- **Bioattacks:** on individuals, e.g. HIV + man deliberately infects women (or vice versa), assassination (political), murder (personal), revenge etc.
  – short term goals

Bioweapons: advantages

- No destruction of buildings (cf. nuclear/ conventional)
- Immunise/ prophylaxis for own side possible (cf. nuclear/ chemical)
- Self-perpetuating (c.f. nuclear/ chemical)
- Easy/ cheap to produce (cf. nuclear/ chemical / conventional)
- Delayed onset for: dissemination/ escape (incubation time)

Bioweapons: requirements

- Easy dissemination/ transmission, person to person (highly contagious)
- High mortality and major public health risk
- Causes public panic and social disruption
- Causing major damage to human environment
- Special action needed for public-health 'preparedness'



Category A Organisms

- Smallpox (*Variola major*)
- Marburg/Ebola (filoviruses) and Lassa/Junin (arenaviruses)

- Anthrax (*Bacillus anthracis*)
- Tularaemia (*Francisella tularensis*)
- Plague (*Yersinia pestis*)

- Botulism toxin (*Clostridium botulinum*)

Targets

- Humans (direct)
- Economical/environmental (indirect)
  - lifestock
  - crops
  - human environment

- viruses
- bacteria
- fungi

Controled of Dual-use Goods

A BRC has procedures to check the validity of customers that wish to receive dangerous organisms and if in doubt does not supply

- Australia Group (1990), now 34 members
  - to prevent supply of substantial harmful organisms to mala fide third parties
- Biological and Toxin Weapons Convention (BTWC), now 162 signatories
  - prohibits the development, possession and use of biological weapons

BRC and Dual-Use

- Accept only written orders
- Check if customer's country is an embargo country
- Inform after intended purpose and use of strain
- Restrict distribution of strains to shipping department
- In case of doubt, contact relevant national office

Biosecurity principles for BRC's

- Physical security
- Security management of personel
- Security management of visitors/guests
- Material control
- Material supply
- Transport security internal and external
- Information security
- Risk assessment

Biosafety Classification of Hazardous Micro-organisms

- 1. Most unlikely to cause human disease
- 2. May cause human disease
  - a possible hazard to laboratory workers but unlikely to spread in the community. Laboratory exposure rarely produces infection and effective prophylaxis or treatment is available
- 3. May cause severe human disease
  - a serious hazard to laboratory workers. Presents a risk of spread in the community but usually effective prophylaxis or treatment.
- 4. Causes severe human disease

  a high risk of spread in the community and there is usually no effective prophylaxis or treatment

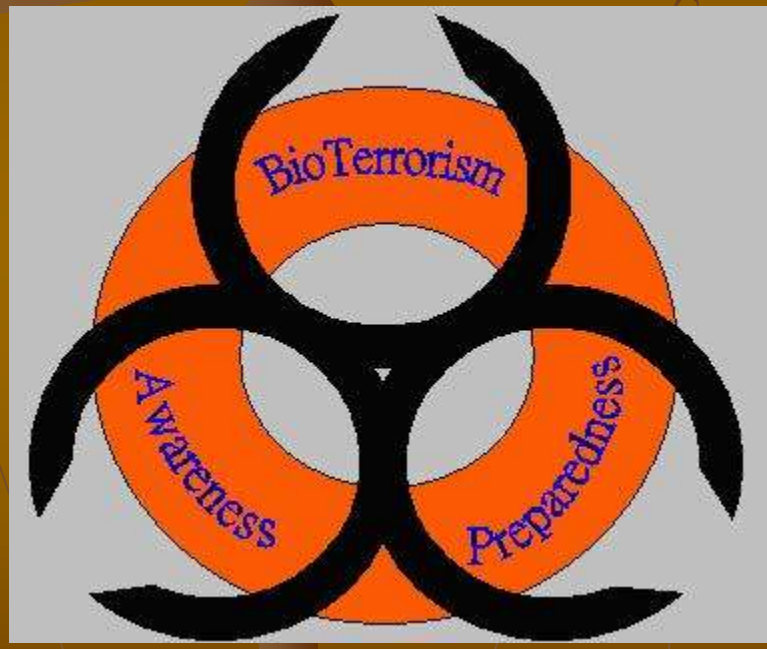
Hazard classification for biosecurity

- 4 categories: Neglegible, Low, Moderate, High

However: based on threats against human, not for example crops

No common lists for human or animal diseases (no agreement among countries)

No uniform evaluation for plant pathogens possible (host, presence, possible occurrence, invasion risk etc.)



Risk Assessment, current practice

- Intended for biosafety, not biosecurity
- Assessment by comparison
  - Substrate
  - Relatives
  - Tests (toxin production)
  - Stay on the safe side
- It worked, up to now

Expected Risk Assessment by BRC's

- Identify sources of potential harm
- Assess potential misuse
  - availability, amplification, necessary skills and knowledge, dispersal, environmental viability (survival chances), effective countermeasures
- Assess virulence
  - infective dose, pathogenicity, lethality, incubation time, transmissibility

What do BRC's need?

- Information
  - Appropriate legislation in various countries
  - Lists of quarantaine organisms (WFCC, GBRCN)
  - Access to external experts
- Testing
  - Access to testing laboratories or possibility to delegate such tasks

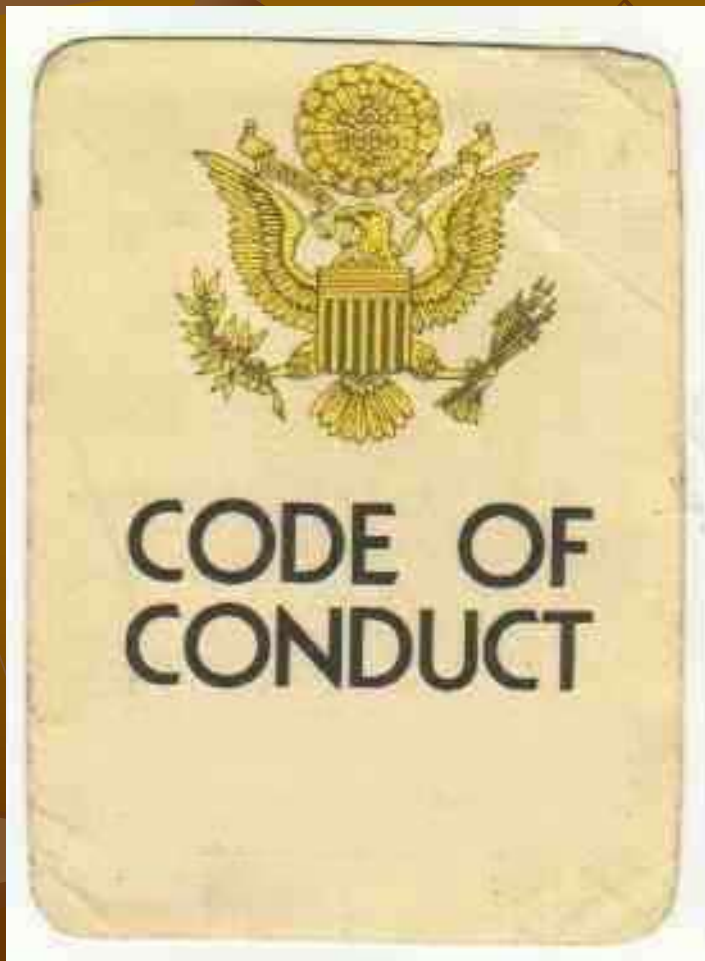
How can BRC's cope?

- Strict application of conditions impossible
- No education in 'terrorist thinking'

- Communication essential (GBRCN)
- Panels of experts

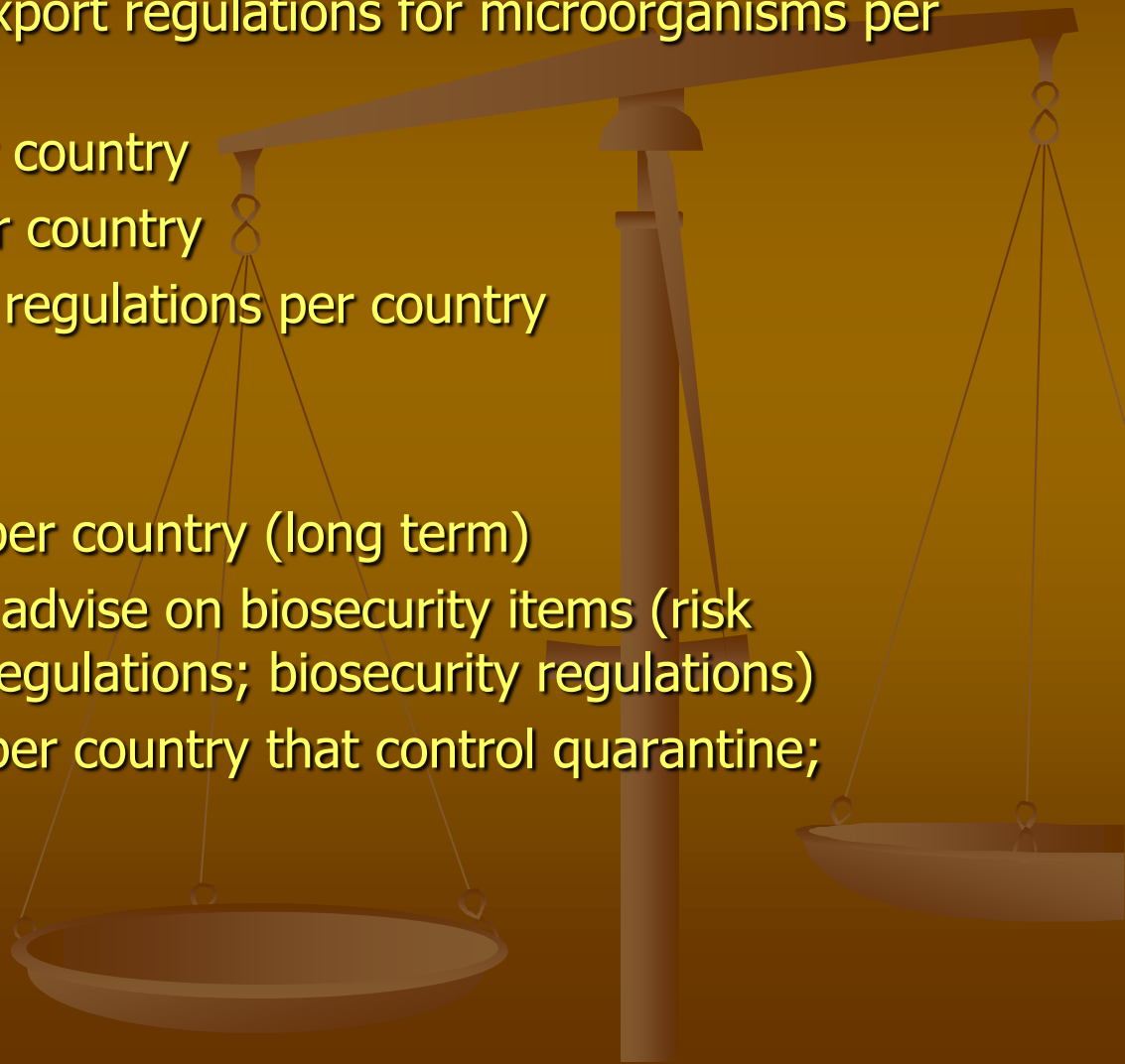
- Stay in contact with authorities
- Avoid panic-inspired actions (IATA, WHO)

- BRC's should develop a Code of Conduct



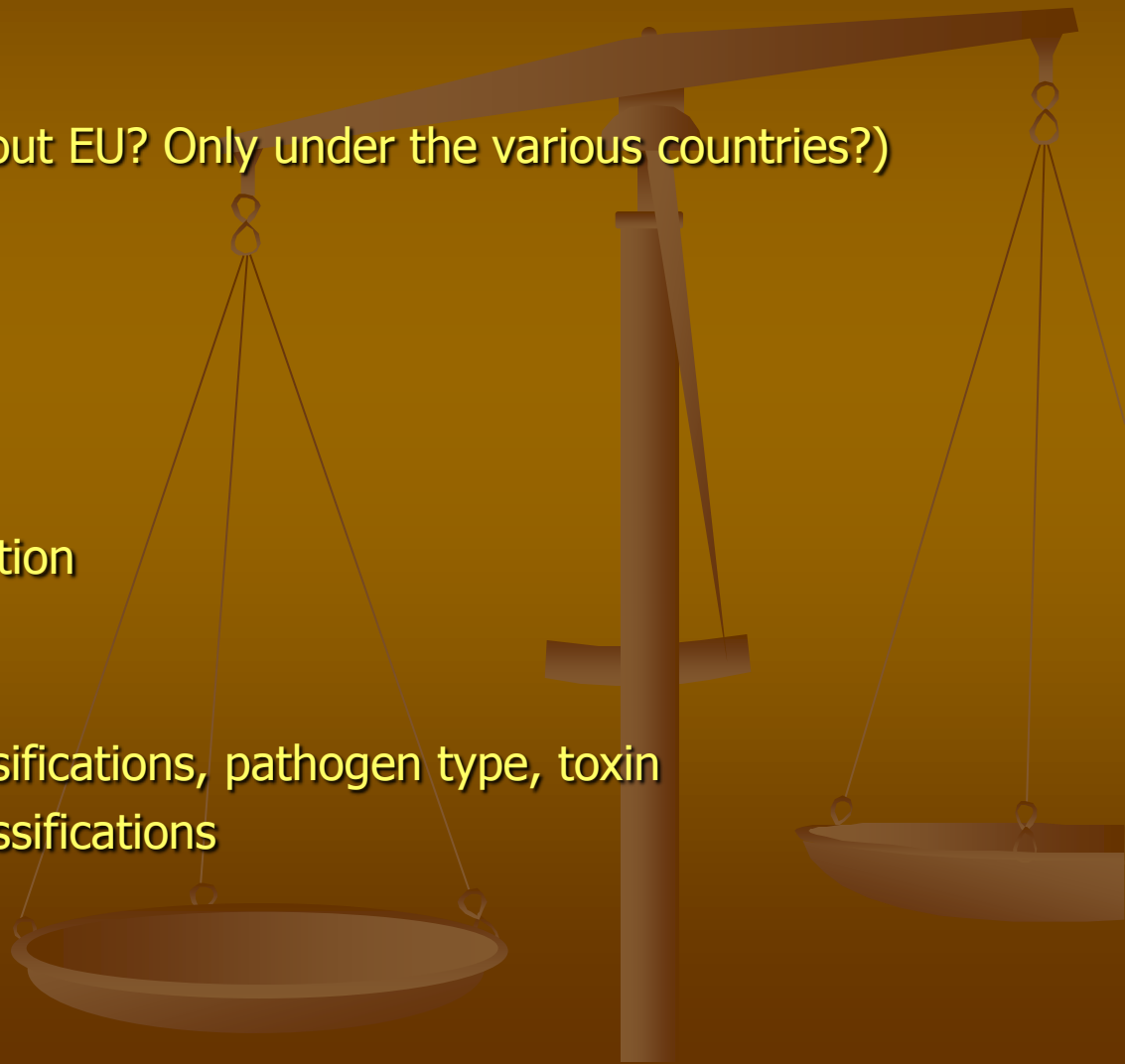
Biosecurity Database - GBRCN

- Legislation: import and export regulations for microorganisms per country
- Transport regulations per country
- Quarantine organisms per country
- Biosafety and biosecurity regulations per country
- List of human pathogens
- List of animal pathogens
- Lists of plant pathogens per country (long term)
- List of experts that could advise on biosecurity items (risk assessment; quarantine regulations; biosecurity regulations)
- Addresses of authorities per country that control quarantine; biosecurity; biosafety



Structure of database

- Fields
  - Name organism
  - Name country (what about EU? Only under the various countries?)
  - Pathogen type
  - Toxin
  - Legislation identity
  - Biosafety classification
  - Biosecurity classification
  - BSL (handling) classification
- Connections between fields
  - Country - Legislation
  - Organism – various classifications, pathogen type, toxin
  - Legislation – various classifications



EMbaRC and GBRCN

- List of relevant literature (December 2009)
- Publication of database (April 2010)
- Draft Code of Conduct
- Workshop
- Final text