Current developments in agricultural science
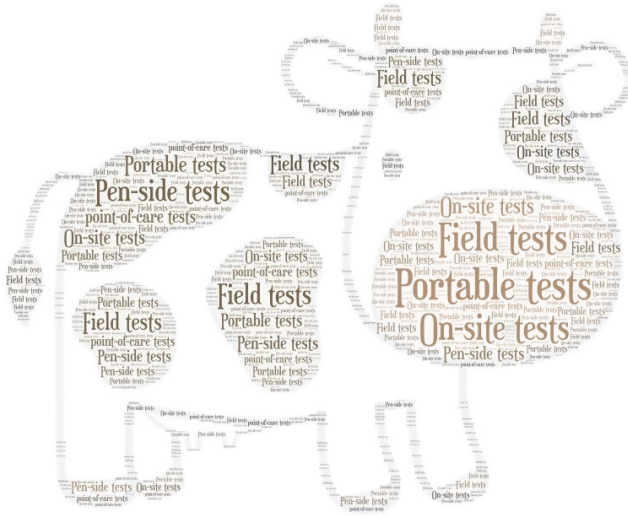## Possible implications for biological security

Christine Uhlenhaut

2nd Annual Global Forum on Scientific Advances Important to the
Biological and Toxin Weapons Convention
Geneva, December 2, 2019

Surveillance / diagnostics

Simple, rapid diagnostic tests – moving away from centralized labs
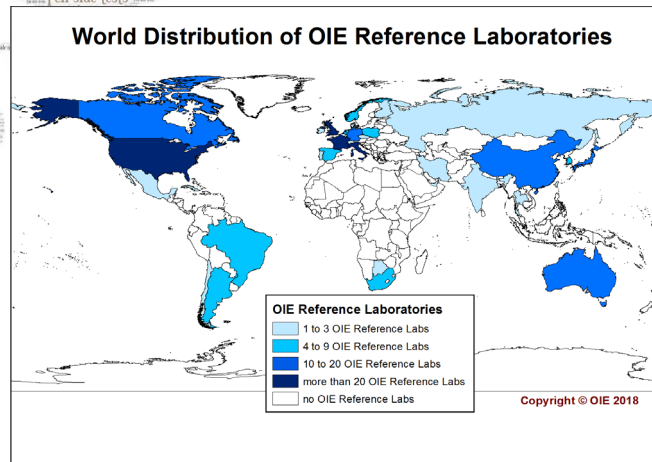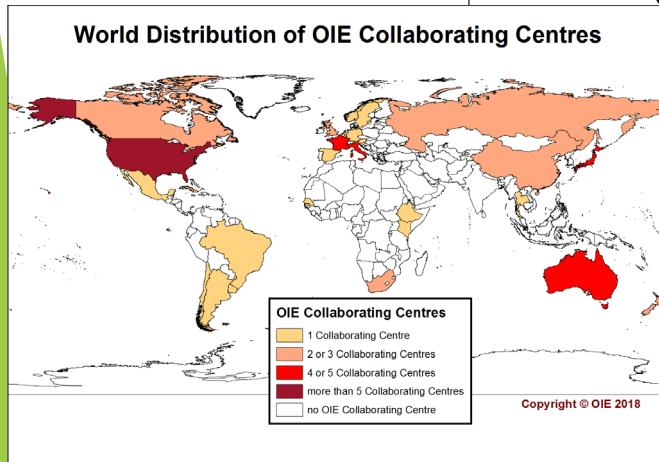
Immunoassays, e.g. lateral flow

Molecular tests, e.g. mobile PCR

Surveillance / diagnostics

Simple, rapid diagnostic tests – moving away from centralized labs

Immunoassays, e.g. lateral flow

Molecular tests, e.g. mobile PCR

World Distribution of OIE Reference Laboratories

OIE Reference Laboratories
- 1 to 3 OIE Reference Labs
- 4 to 9 OIE Reference Labs
- 10 to 20 OIE Reference Labs
- more than 20 OIE Reference Labs
- no OIE Reference Labs

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World Distribution of OIE Collaborating Centres

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BSL4Z NET
Biosafety Level 4 Zoonotic Laboratory Network

Canada
UK
Germany
USA
Australia

Applied research

Gene drive – possible applications

- Confer resistance to
    - Porcine reproductive and respiratory disease virus
    - African Swine Fever
    - Infectious pancreatic necrosis virus in Atlantic salmon
    - Targeted mutagenesis to prevent rice blast disease
- Create improved models, e.g. to study pathways, drug targets
- Produce more muscular animals
- Produce cows without horns
- Producing offspring of a single sex (e.g. milk, egg production)
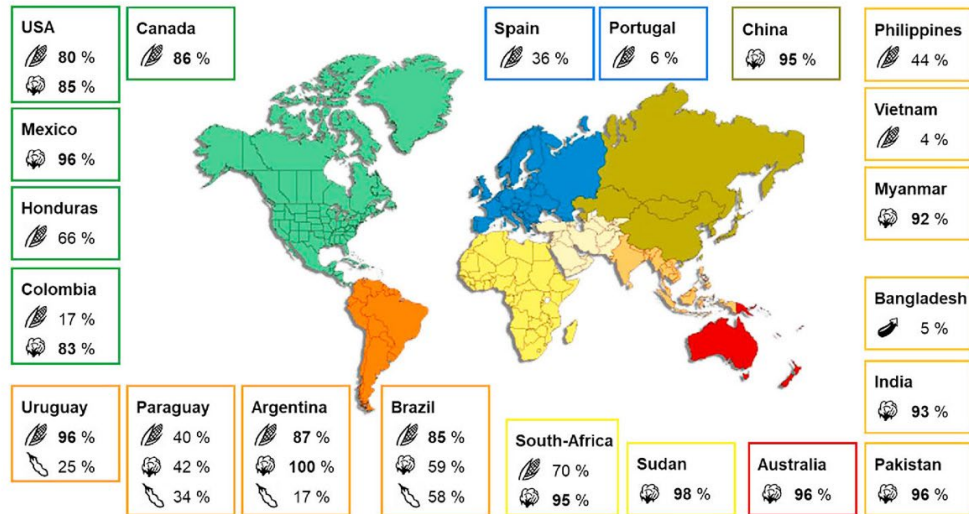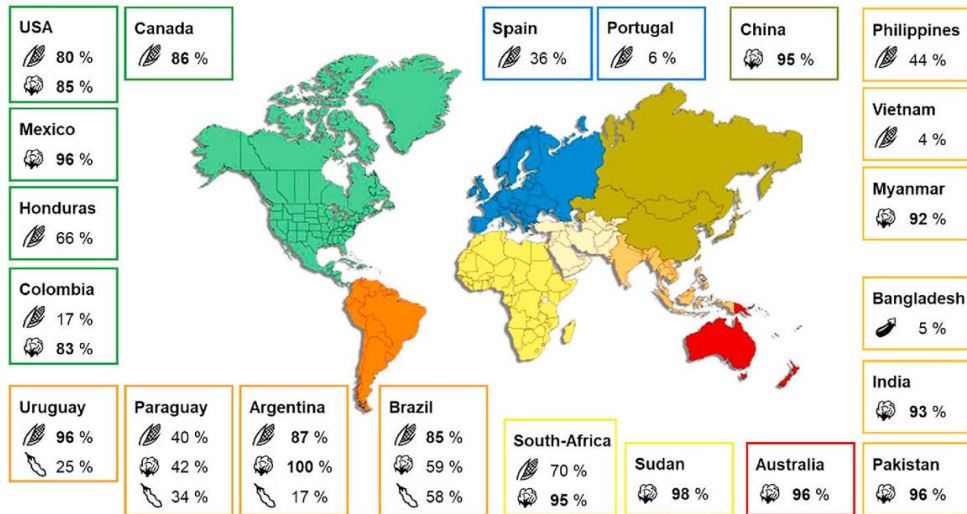
On the market

Fig. 1. Global adoption (in %) of GE crops (maize, cotton, soybean, eggplant) with insect-resistance traits (either alone or stacked with HT traits) in 2017 (data source: ISAAA, 2017). Only countries are listed where the biotech crop was grown on > 1000 ha. Adoption levels > 80% are highlighted in bold. In the case of Vietnam and Spain, adoption levels were calculated based on data from the USDA Foreign Agricultural Service (www.fas.usda.gov).

- Bt crops (rDNA)
- Herbicide-resistant crops (rDNA)
- Pesticide-resistant crops (rDNA)
- Fluorescent zebrafish
- Transgenic laboratory animals
- Yeast-derived products (vanillin, stevia, egg whites, gelatin)
- V. natriegens platform

GloFish.com

On the market

USA	Canada
🌽 80 %	🌽 86 %
🐑 85 %	

Mexico
🐑 96 %

Honduras
🌽 66 %

Colombia
🌽 17 %
🐑 83 %

Uruguay
🌽 96 %
🐚 25 %

Paraguay
🌽 40 %
🐑 42 %
🐚 34 %

Argentina
🌽 87 %
🐑 100 %
🐚 17 %

Brazil
🌽 85 %
🐑 59 %
🐚 58 %

Spain	Portugal
🌽 36 %	🌽 6 %

China
🐑 95 %

Philippines
🌽 44 %

Vietnam
🌽 4 %

Myanmar
🐑 92 %

Bangladesh
🍆 5 %

India
🐑 93 %

South-Africa
🌽 70 %
🐑 95 %

Sudan
🐑 98 %

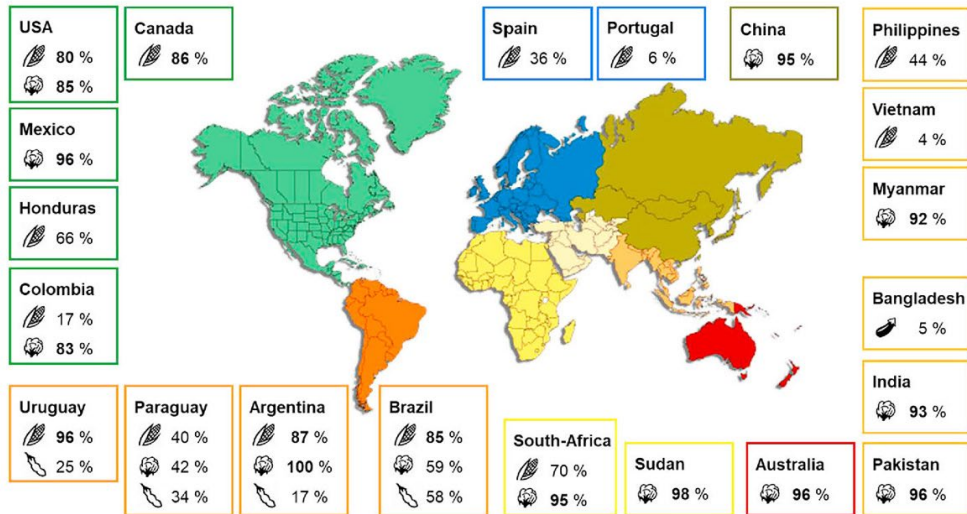| Australia |
|---|
| 🐑 96 % |

Pakistan
🐑 96 %

Fig. 1. Global adoption (in %) of GE crops (maize, cotton, soybean, eggplant) with insect-resistance traits (either alone or stacked with HT traits) in 2017 (data source: ISAAA, 2017). Only countries are listed where the biotech crop was grown on > 1000 ha. Adoption levels > 80% are highlighted in bold. In the case of Vietnam and Spain, adoption levels were calculated based on data from the USDA Foreign Agricultural Service (www.fas.usda.gov).

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GloFish.com

Under development
- Fragrant moss
- DIY glowing plants
- Genome-edited crops
- Genome-edited animals
- Plants as sentinels
- Increased photosynthesis plants
- Landmine detecting mice
- Revived animals extinct or nearly so
- Animals with gene drives for control of insects or invasive mammals
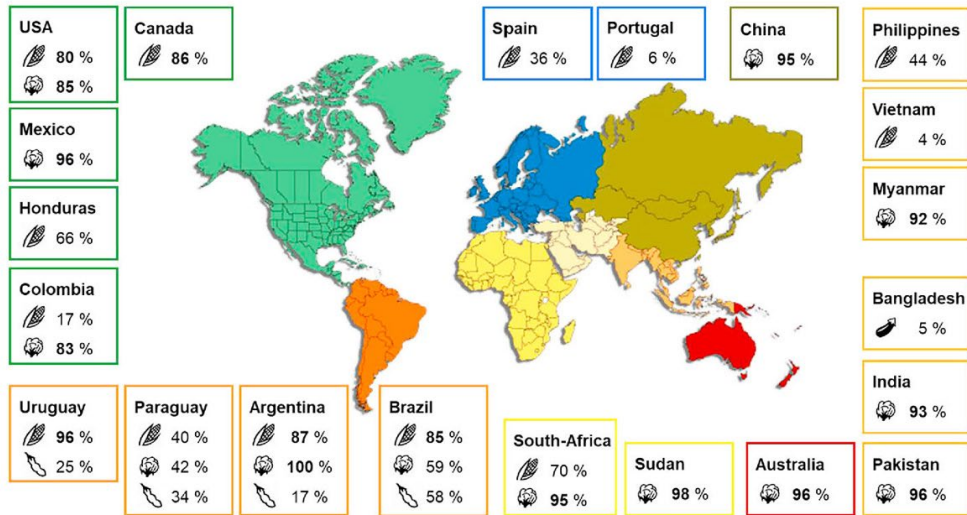
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Proudfoot *et al.*, 2015

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Proudfoot *et al.* 2015

Cattle with a precise, zygote-mediated deletion safely eliminate the major milk allergen beta-lactoglobulin

Jingwei Wei[1], Stefan Wagner[1,2], Paul Maclean[1], Brigid Brophy[1], Sally Cole[1], Grant Smolenski[1,3], Dan F. Carlson[4], Scott C. Fahrenkrug[4], David N. Wells[1] & Götz Laible[1]

Synthetic Biology

What is this: H_2O ?
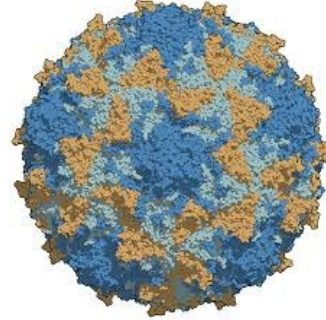
Synthetic Biology

What is this: H_2O ?

Synthetic Biology

What is this: H_2O ? And this: $C_{332652}H_{492388}N_{98245}O_{131196}P_{7501}S_{2340}$?

Synthetic Biology

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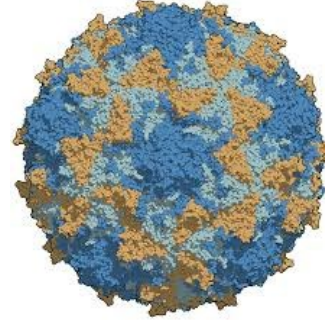
Poliovirus

Synthetic Biology
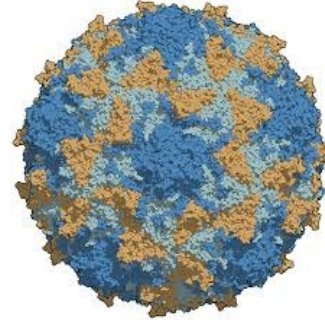
What is this: H_2O ? And this: $C_{332652}H_{492388}N_{98245}O_{131196}P_{7501}S_{2340}$?

Poliovirus

Did Pox Virus Research Put Potential Profits Ahead of Public Safety?

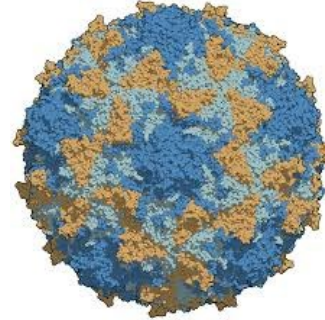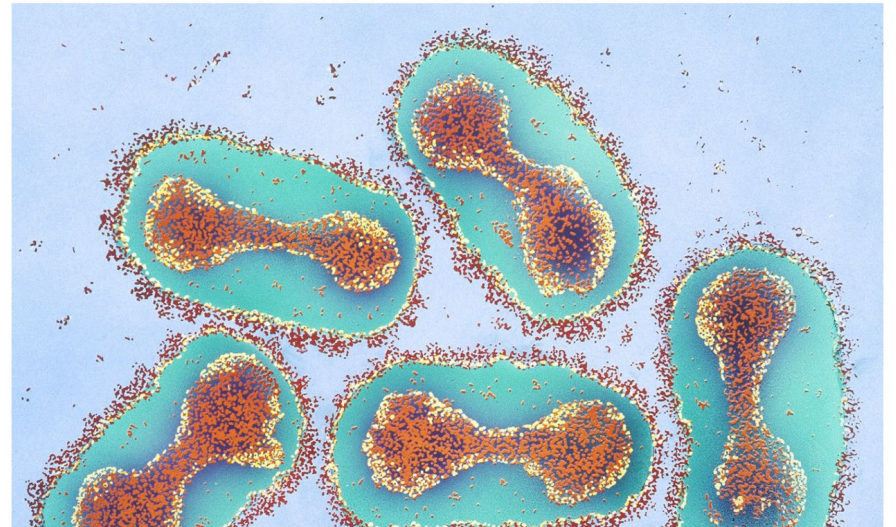February 17, 2018 · 8:08 AM ET
Heard on Weekend Edition Saturday

NELL GREENFIELDBOYCE
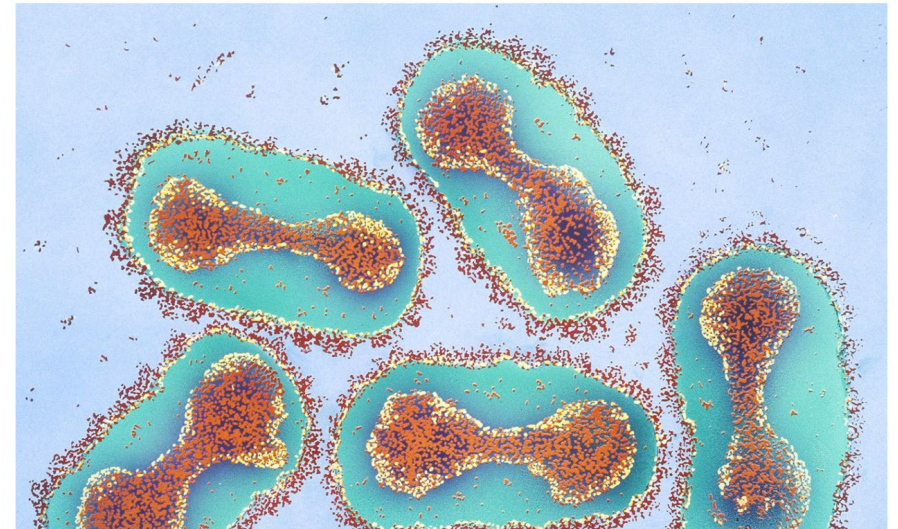
Synthetic Biology

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Poliovirus

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February 17, 2018 · 8:08 AM ET
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NELL GREENFIELDBOYCE

Vaccines

CEPI rapid response platforms portfolio

mRNA vaccine printer
Yellow Fever, Lassa, Rabies

self-amplifying RNA (saRNA)
Influenza, Rabies, Marburg

molecular clamp
RSV, Influenza, MERS

Vaccines

CEPI rapid response platforms portfolio
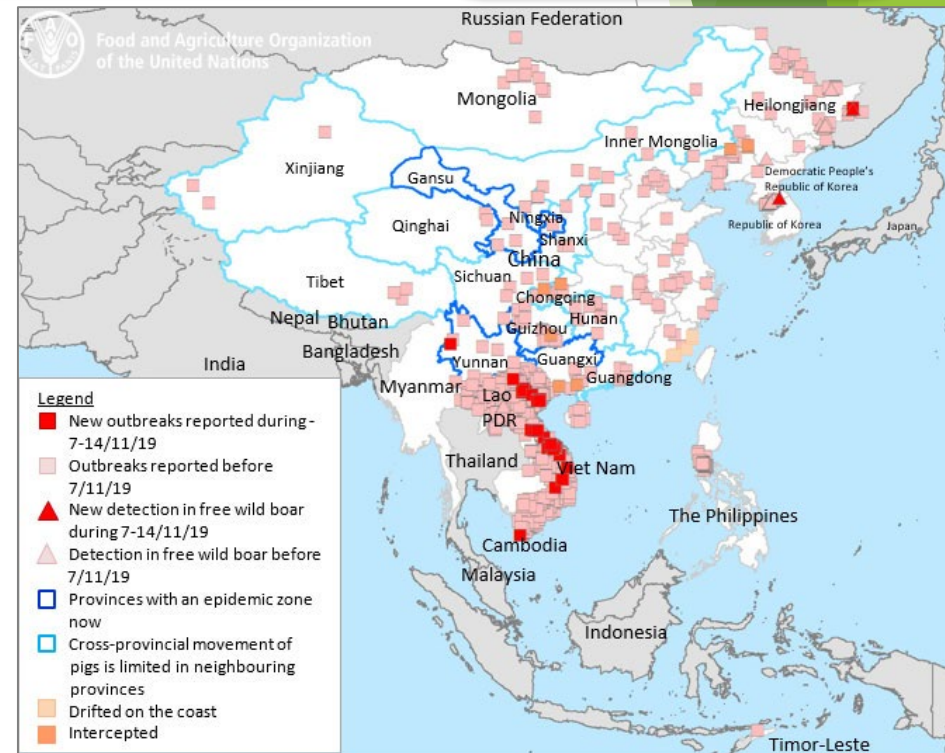

mRNA vaccine printer
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CEPI rapid response platforms portfolio

CUREVAC
the RNA people®

mRNA vaccine printer
Yellow Fever, Lassa, Rabies

Imperial College London

self-amplifying RNA (saRNA)
Influenza, Rabies, Marburg

THE UNIVERSITY OF QUEENSLAND AUSTRALIA
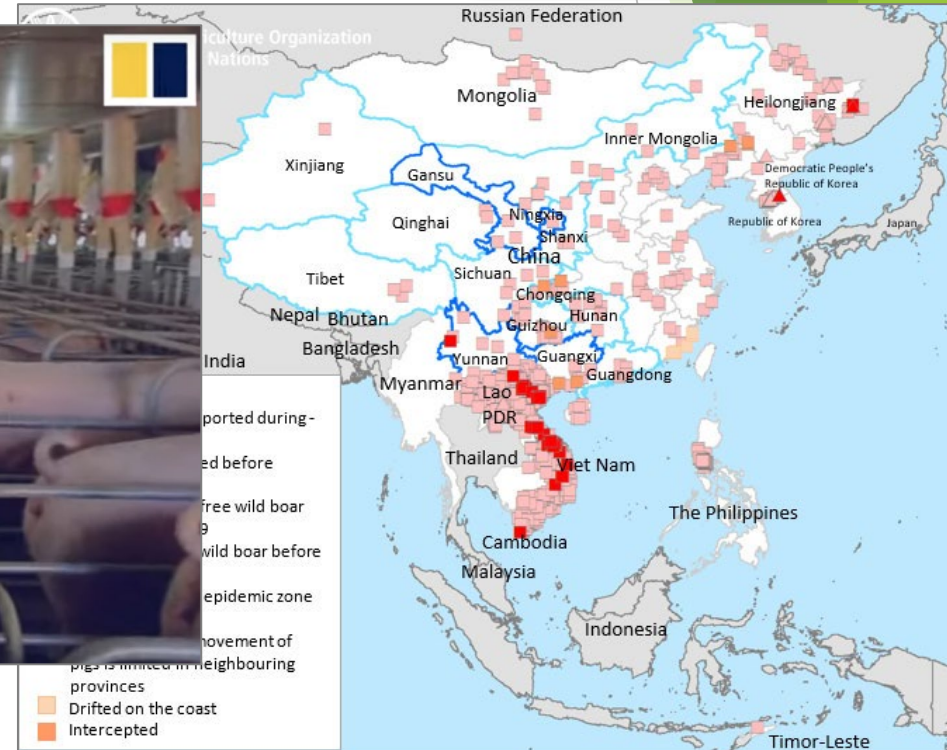
molecular clamp
RSV, Influenza, MERS

Source: CCTV
Hebei, China

25%
of the global pig population is expected to die
in an epidemic of African swine fever

World Organisation for Animal Health
October 31, 2019

Drones

Agricultural drones are used for

- Crop spraying and spot spraying
- Soil and field analysis
- Seed planting
- Crop mapping and surveying
- Irrigation monitoring and management
- Real-time livestock monitoring

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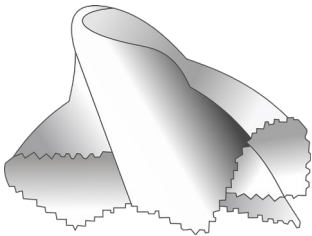
Other issues

Counterfeit drugs & fake news

Other issues

Counterfeit drugs & fake news

Other issues

Counterfeit drugs & fake news

FarmJournal's
PORK

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NEWS ▾   MARKETS ▾   MANAGEMENT RESOURCES ▾   AUDIO & VIDEO ▾   CONTRIBUTORS ▾

Gangs in China Fake Outbreaks of African Swine Fever

Jennifer Shike
July 12, 2019 10:21 AM

🖶 Print

African SWINE FEVER

Other issues

Counterfeit drugs & fake news

MMR uptake at 16 months and proportion of mothers believing in complete or almost complete safety of MMR vaccine

FarmJournal's PORK

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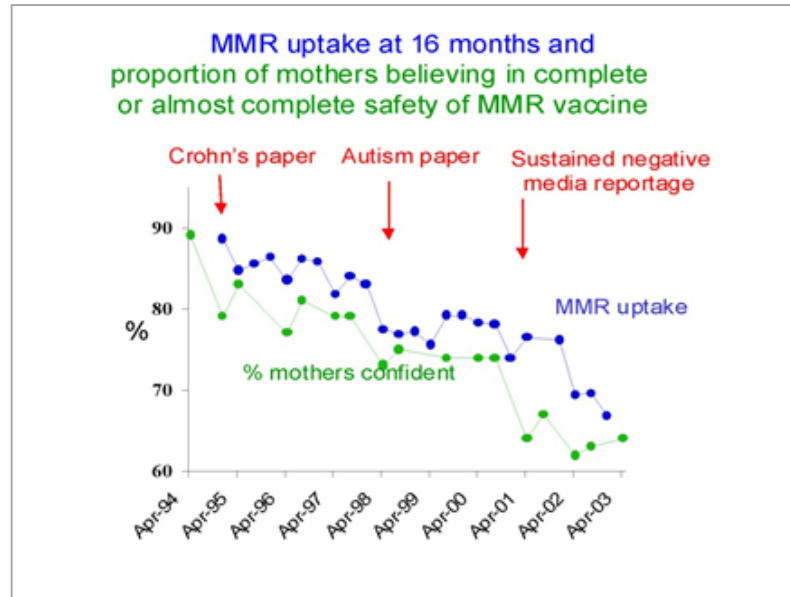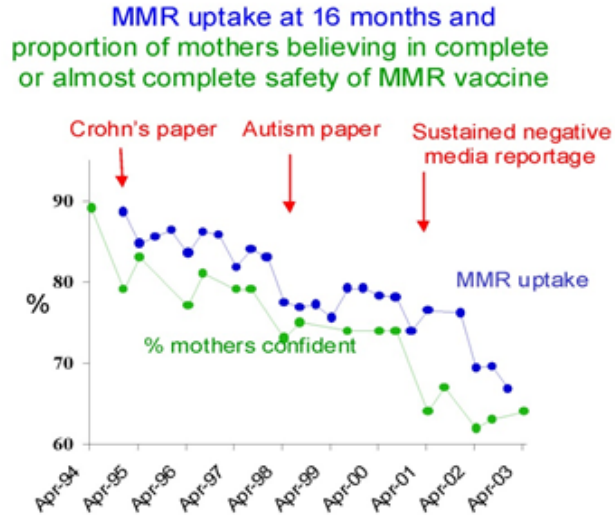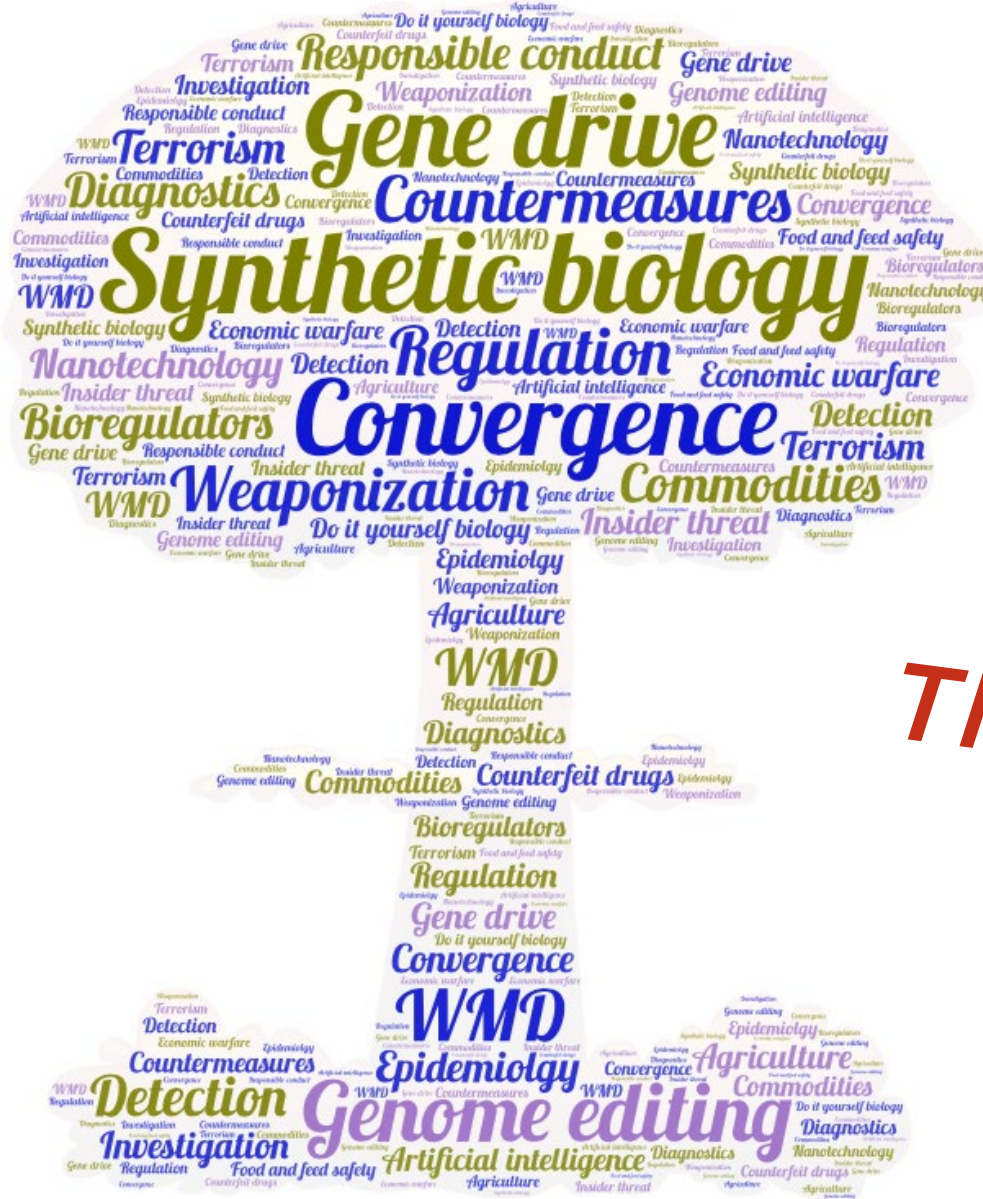Jennifer Shike
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Crohn's paper   Autism paper   Sustained negative media reportage

MMR uptake

% mothers confident

Armed groups kill Ebola health workers in eastern DR Congo

MONUSCO | Peacekeepers from the UN Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO) on patrol in the Irumu Territory, Ituri, to deter ADF activities.

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July 12, 2019 10:21 AM

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African SWINE FEVER

And there is so much more…

Thank you