

Development of early warning systems to detect, predict and assess food fraud

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14/06/2018



Outline

- Prediction of food fraud using machine learning: Bayesian Network approach
- Food fraud early warning system using European media monitor (EMM)

To predict food safety issues/ problems a system approach is needed

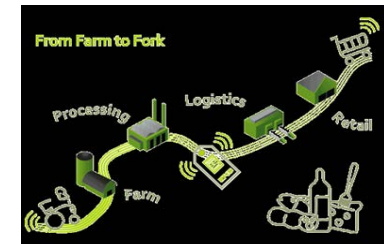
- Prediction of food fraud is a challenge because food fraud is driven by many factors, directly and indirectly.



DATA FROM DRIVERS



EXPERT KNOWLEDGE



HOST ENVIRONMENT ANALYSIS

Requirements of a system approach

To predict food safety issues/ problems a system approach is needed

- Machine learning models such as Bayesian Networks (BN) may be able to deal with such complexity.
- BN is used in many other sectors (some examples):



Medical systems

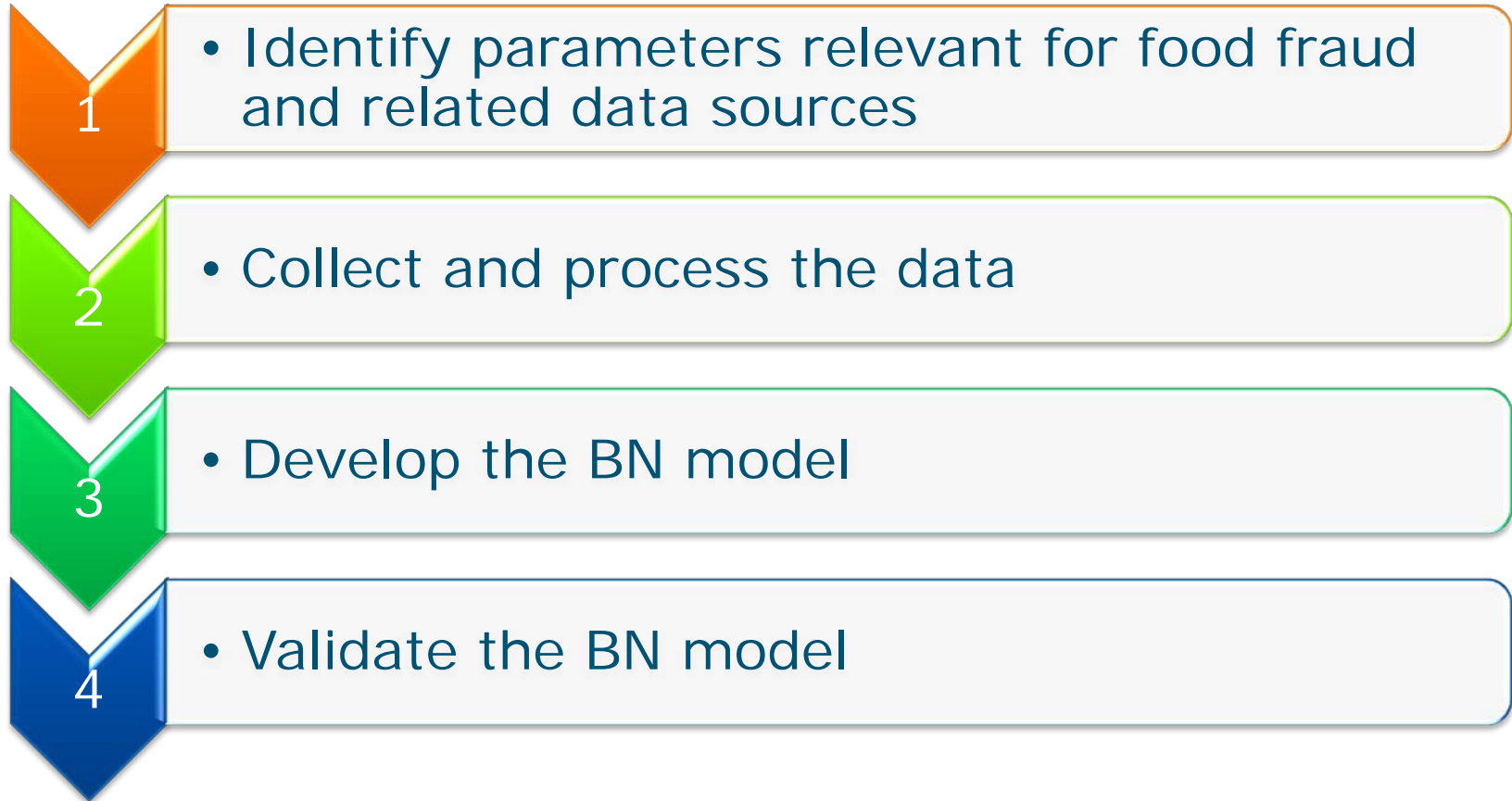
- Predict the occurrence of brain metastasis from lung cancer (Wang *et al.* 2014)
- Explored genetic epidemiology with BNs (Rodin *et al.* 2012)
- Prediction probabilities of certain features indicative of non-organ confined prostate cancer (Chakraborty *et al.* 2012)



Energy

- Situation assessment of nuclear power plant operators (Kim and Seong 2006)
- Decision-making in electrical power systems (Buriticá and Tesfamariam 2015)

Application of BNs to predict food fraud



Application of BNs to predict food fraud

1. Identify parameters relevant for food fraud and related data sources:

- Identifying potential drivers of food fraud using literature and expert elicitation (brainstorm).

Economic parameters



- Prices of the fraudulent products
- Price spike around the period of detection
- Trade volumes, complexity of the food chain

Parameters of the country of origin & detection



- Corruption index, food safety index
- Governance index, legal system index
- Human development index
- ...

Application of BNs to predict food fraud

2. Collect and process the data

- Food fraud incidents as reported in Rapid Alert System for Food and Feed (RASFF) and Economically Motivated Adulteration incidents database (EMA) were collected from 2000 to 2015.
- In total 1686 food fraud incidents were reported.
- For each food fraud incident additional data was collected from the identified drivers, either from online data sources, literature, or food fraud experts.

Data sources use in the model

linking 36 data sources (18 databases and 8 expert judgements)

The image displays a central network diagram with nodes labeled: FraudRisk..., Or_CPI, Product_n..., Product_Pr..., Notified_Co..., Or_Lu..., and global_i... These nodes are interconnected by a dense web of lines, representing the integration of 36 data sources. Surrounding the diagram are screenshots of various data sources:

- Eurostat:** "Your key to European statistics" with sections for News, Data, and Publications. A featured article discusses price levels varied by almost one to three across the EU Member States in 2014.
- USP (U.S. Pharmacopeial Convention):** Website for USP-NF, USP-MF, and USP-V, including sections for Food Chemicals, Food Reference Standards, and USP's Food Fraud Database.
- Transparency International:** "THE 2014 CORRUPTION PERCEPTIONS INDEX MEASURES THE PERCEIVED LEVELS OF PUBLIC SECTOR CORRUPTION IN 175 COUNTRIES AND TERRITORIES". Includes a world map showing corruption levels.
- World Bank:** "GDP growth (annual %)" data page with search filters and download options.
- PRS (Political Risk Services):** "Regional Political Risk Index (as of April 2015)" page.
- World Press Freedom Index 2014:** "BIGGEST RISES AND FALLS IN THE 2014 WORLD PRESS FREEDOM INDEX" article.
- CIPS (Chartered Institute of Procurement & Supply):** "CIPS Risk Index" page, describing the index's purpose in assessing supply chain risks.
- Other sources:** Resilience Index, U.S. Pharmacopeial Convention, RASFF Portal, Human Development Reports, and Global Food Security Index.

Application of BNs to predict food fraud

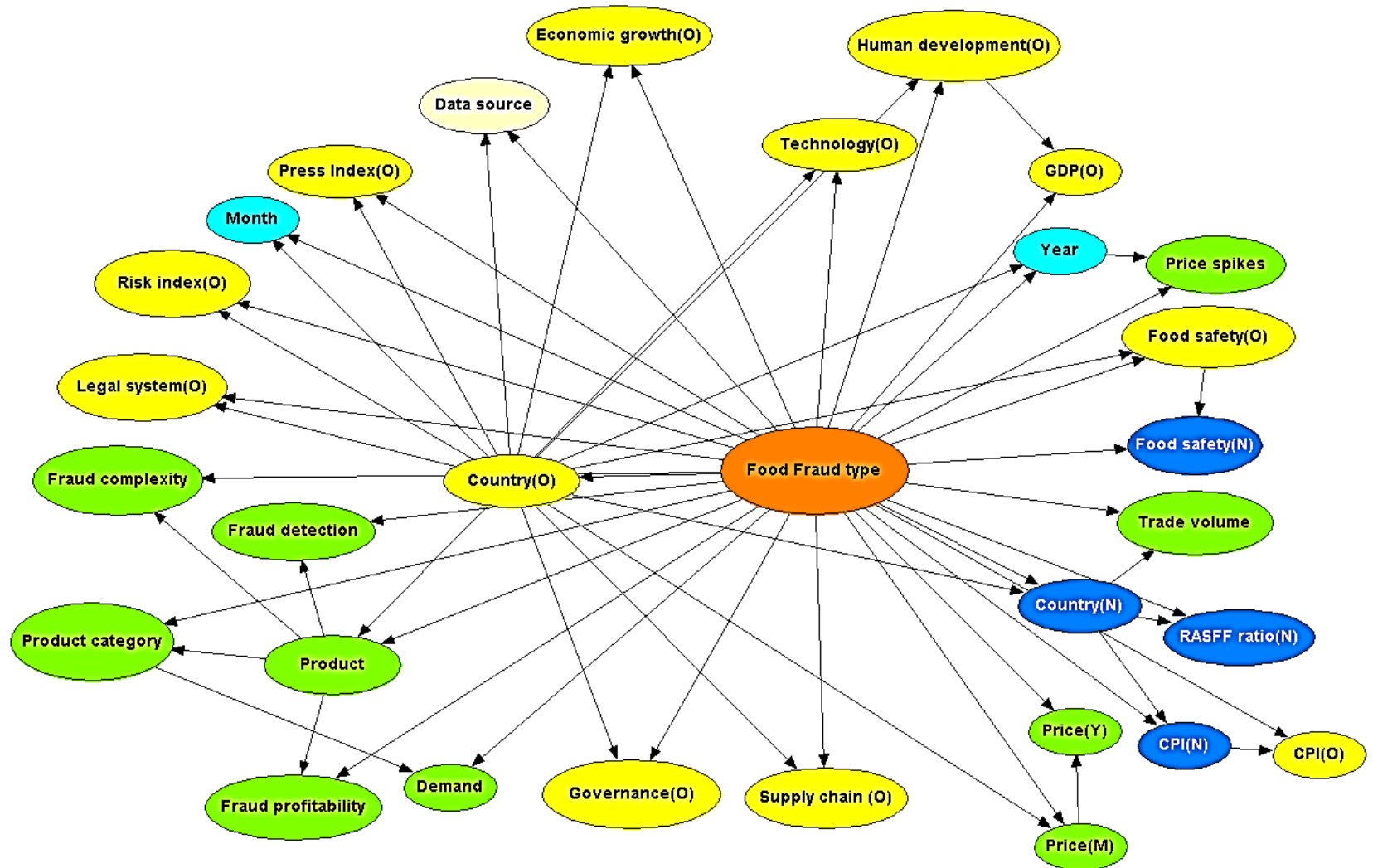
3. BN construction

- BN was built to predict food fraud type using the learning algorithm of the Hugin 8.4 software (i.e. Tree augmented naive Bayes algorithm).
- In total **1392** different cases (i.e. 83% of the total data set) were used in this step.

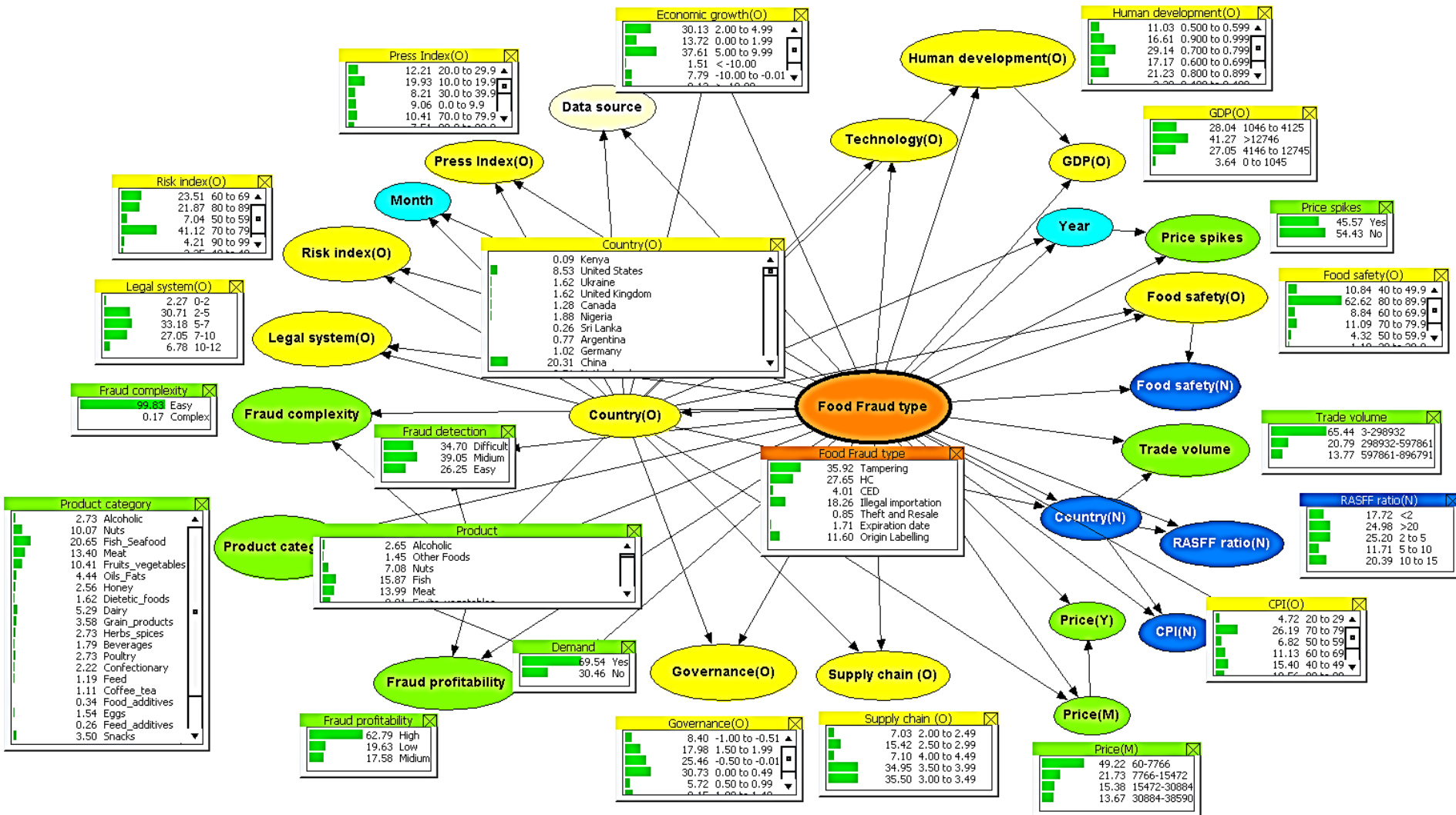
4. BN Validation

- 17% of the collected data (i.e. 293 cases) were used to validate the BN model.
- Accuracy of the prediction of the type of food fraud is **91.5%**

BN model to predict food fraud

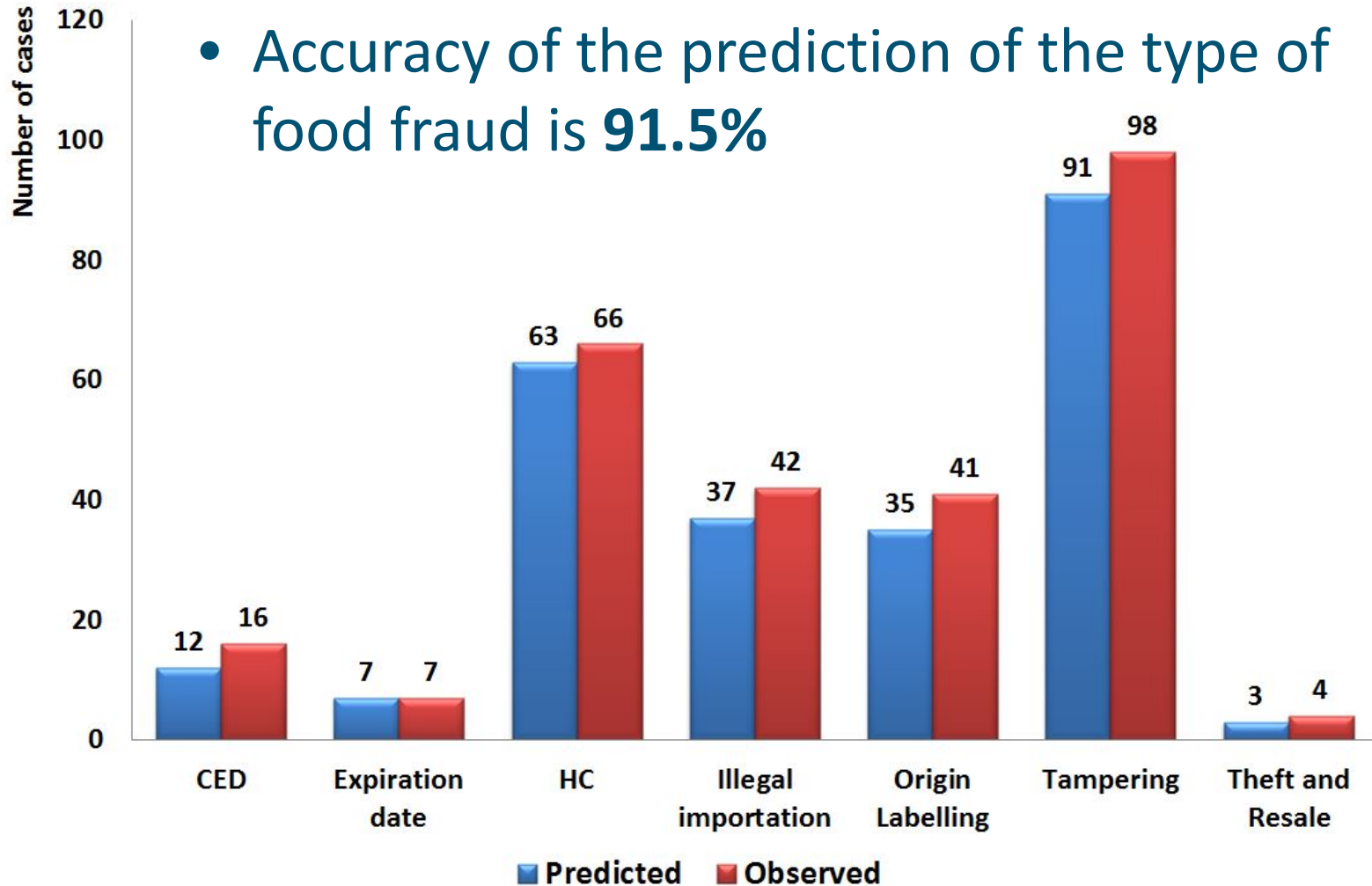


BN model to predict food fraud



Validation results

- Accuracy of the prediction of the type of food fraud is **91.5%**



Forecasting using BN model; an example

TREND:

China is investing to improve their food safety system. It is expected that food safety will improve in the coming 5 years.

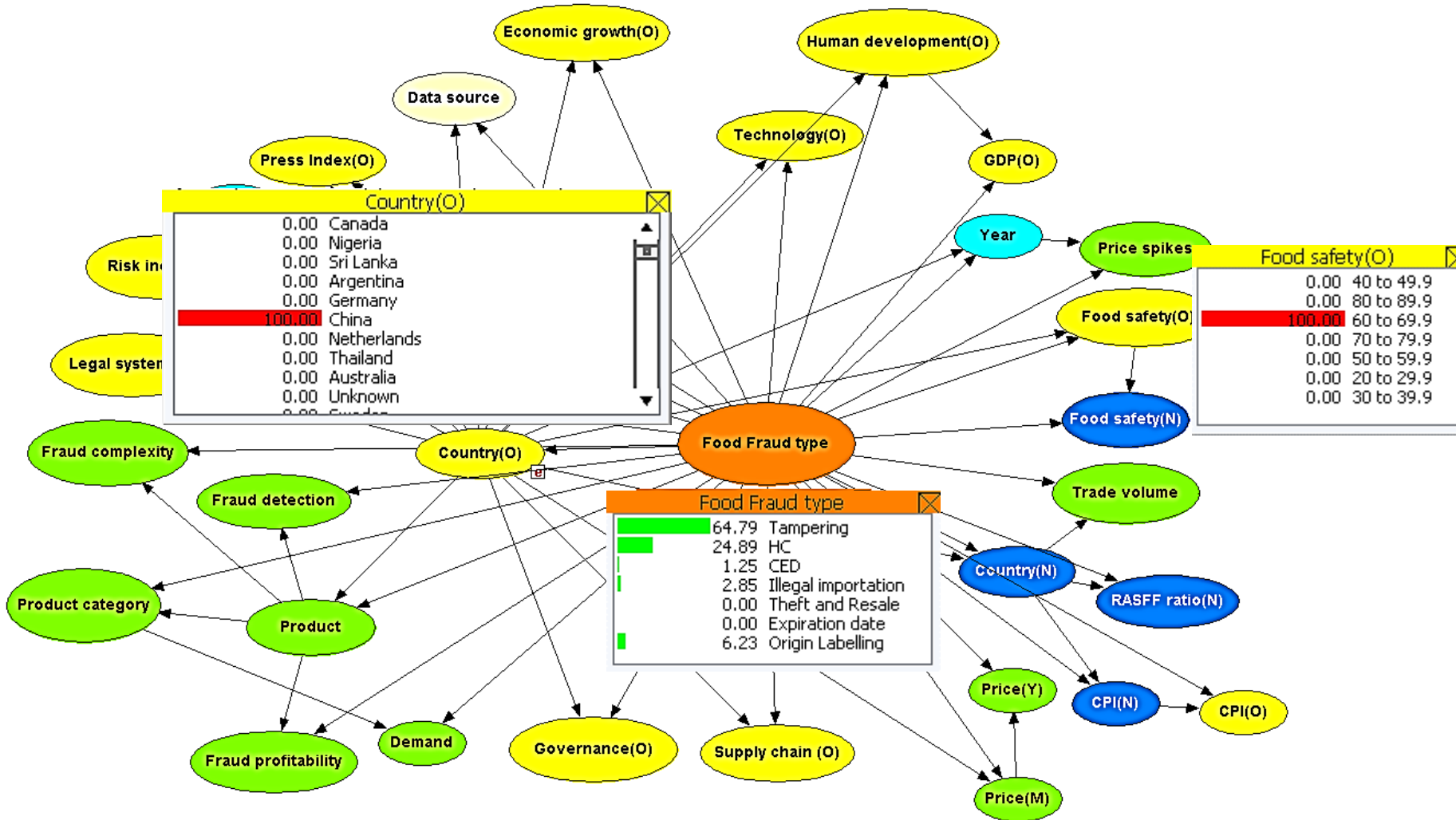
Scenario

Food safety index of China will increase from 69.3 (ranking 39^e in 2015) to 80 in 2020 (ranking 26^e based on list 2015)

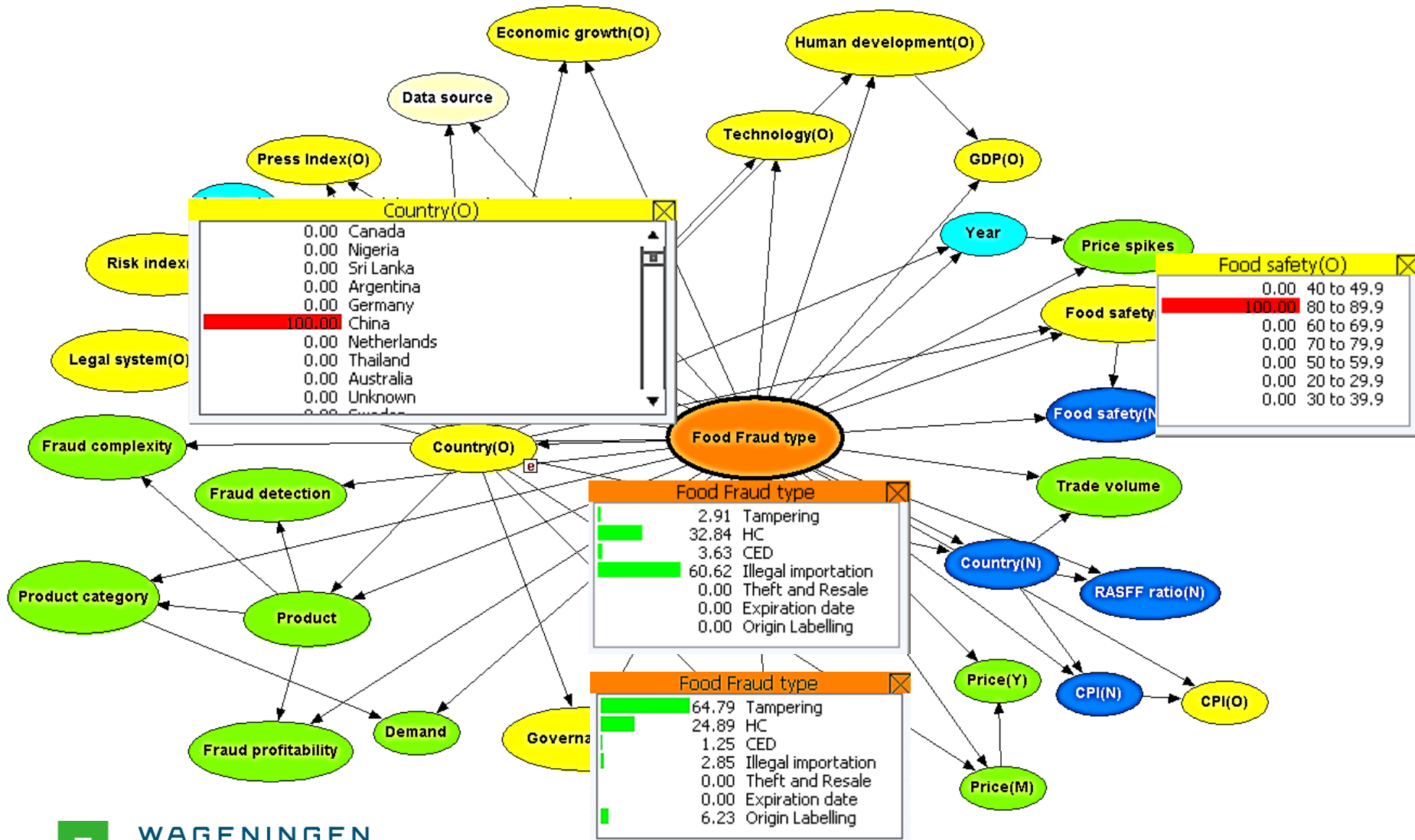
Question

Will this effect the type of fraud of products imported to Europe from China?

Scenario 1: China 2015



Scenario 2: China 2020



Application of BNs to predict food fraud

Food Research International 89 (2016) 463–470



Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres



A holistic approach to food safety risks: Food fraud as an example

Hans J.P. Marvin *, Yamine Bouzembrak, Esmée M. Janssen, H.J. van der Fels- Klerx,
Esther D. van Asselt, Gijs A. Kleter

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- Prediction of food fraud using machine learning: Bayesian Network approach
- Food fraud early warning system using European media monitor (EMM)

The Europe Media Monitor characteristics

- EMM applies text mining techniques to screen different types of media on the world wide web: websites, databases, blogs, ..etc.
- EMM is updated every 10 minutes, 24 hours per day, and gathers reports from news portals world-wide in 60 languages.
- EMM contain 3 portals: NewsBrief, NewsExplorer and MedISys

(<http://emm.newsbrief.eu/overview.html>)

MedISys: public health related topics


advanced search

- Top Stories
- Event Extraction
- Recent Disease Incidents
- Alert Statistics >
- Communicable Diseases >
- Symptoms >
- Bioterrorism >
- Nuclear >
- Chemical >
- ECDC >
- EFSA >
- EMCDDA >
- ENV_RISKS >
- Medical Devices >
- Vaccination >
- Other >
- Continents >
- Official Sources >
- Sources List

Most Active Topics

tropical medicine

In combination with: **India;**

Nipah virus test results likely to be out today: Bats are just one theory

timesofindia Friday, May 25, 2018 10:58:00 AM CEST | info [other]

THIRUVANANTHAPURAM: The horizontal line of transmission of Nipah virus , from one person to another along with varying periods of incubation have prompted the animal husbandry department (AHD) to probe multiple sources of infection. Pathologists and disease control specialists associated with AHD.....

Indian child dies from mother's 'snake bite' breast milk

afp-english Friday, May 25, 2018 10:38:00 AM CEST | info [other]

An Indian woman who was bitten by a snake in her sleep and unknowingly breastfed poisoned milk to her daughter has died along with the child, police said Friday. The 35-year-old woman from Uttar Pradesh state did not realise she had been bitten when she woke and breastfed her daughter....

White Powder

In combination with: **United States of America;**

White Powder Found At Aaron Schlossberg's Building

newsweek Friday, May 25, 2018 4:25:00 AM CEST | info [other]

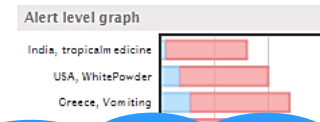
The New York City Fire Department confirmed to Newsweek Thursday after a search of public records as containing the law office of Aaron Schlossberg, the lawyer

View More Video

theolympian Friday, May 25, 2018 4:13:00 AM CEST | info [other]

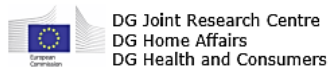
Video released by the Philadelphia Police shows a man blocking an SUV driver and passengers in a parking lot and smashing the SUV window and striking a passenger with a sledgehammer. Police say the incident may be related to road rage. Florida Southern College Moccasins baseball player Christian.....

Tools	
Friday, May 25, 2018 2:12:00 PM CEST	
manage	
info	



No collection of publications on food fraud

Full statistics...



DG Joint Research Centre
DG Home Affairs
DG Health and Consumers

Manuals/Tutorials (access to wiki upon request)
Contact: jrc-emm-info@ec.europa.eu
disclaimer.

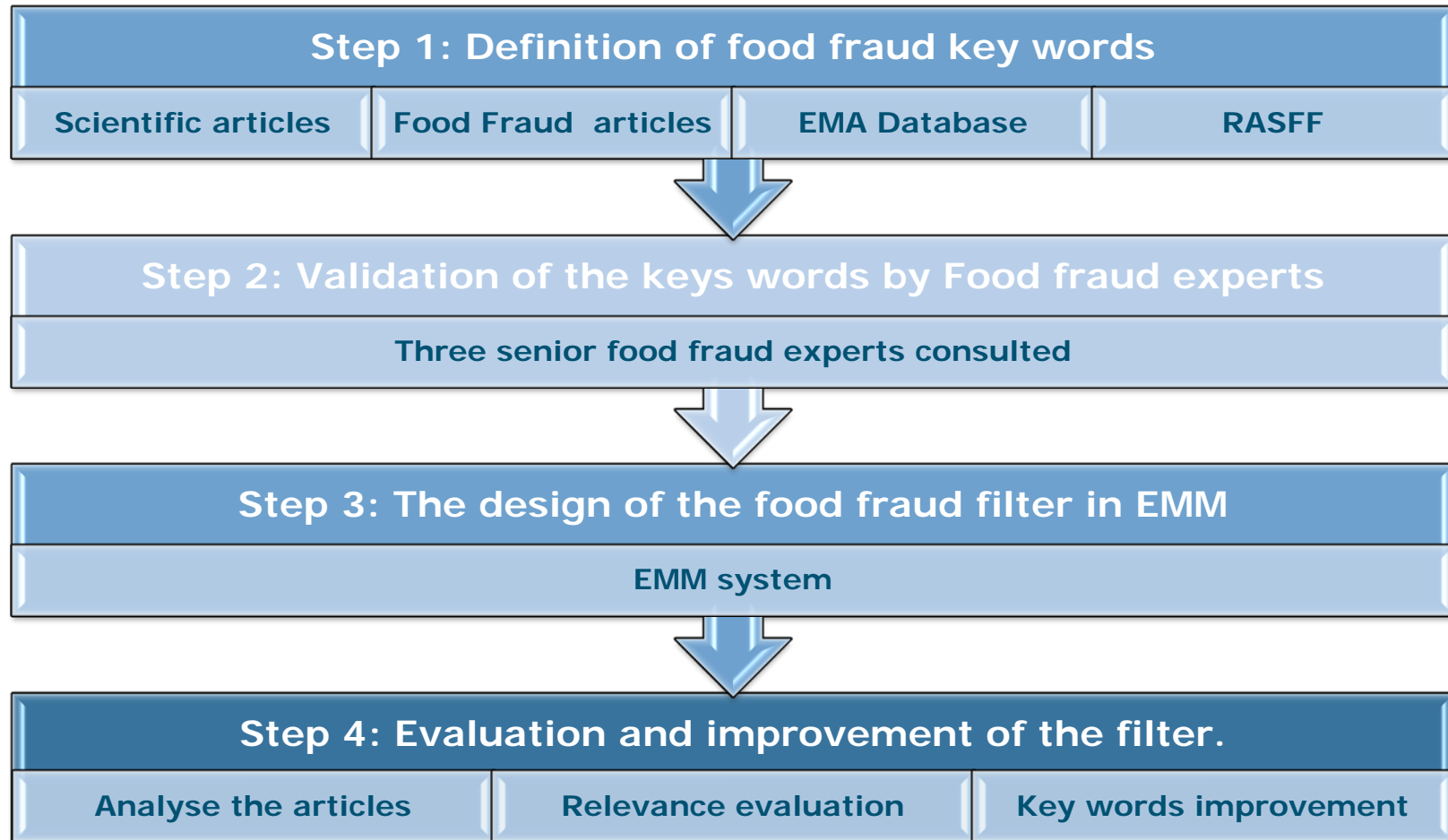


European Food Safety Authority
Committed to ensuring that Europe's food is safe



<http://medusa.jrc.it/medisys/homeedition/en/home>

EMM Food Fraud Filter Design steps



Key Words Languages

Spanish



Italian



German



English



French



Chinese



Arabic



Dutch



MedISys adapted to detect food fraud



DISRUPTIVE TECHNOLOGIES | Active & Intelligent Packaging
FOR THE NEW PACKAGING AGE | WORLD CONGRESS
Amsterdam November 19-20 2018

- Top Stories
- Event Extraction
- Recent Disease Incidents
- Alert Statistics
- Communicable Diseases
- Symptoms
- Bioterrorism
- Nuclear
- Chemical
- ECDC
- EFSA
- EMCDDA
- ENV_RISKS
- Medical Devices
- Vaccination
- Other
- Continents
- Official Sources
- Sources List

Latest News About - FoodIn

Articles published more than 1 year ago

Kriminalität: Behörden
BerlinMorgenpost Tuesday, June 12, 2018
Berlin. Viele Berliner Verbraucher haben in Supermärkten und Online-Läden Lebensmittelbetrug entdeckt.

Articles published more than 1 year ago

Es wäre so schön, wenn
Welt Saturday, June 9, 2018
Eine Mahlzeit in einem Restaurant ist eine Sozialisierung und oft ein gemeinsames Erlebnis. In der digitalen Welt wird dies durch Social Media verstärkt.

Brief: Chinese police
securingindustry Saturday, June 9, 2018
The authorities in China have cracked down on counterfeit liquor, making it more difficult for counterfeiters to operate also netter says the report....

Illegal dairy unit unearthed
shenews-pk Saturday, June 9, 2018
LAHORE: Punjab Food Authority (PFA) on Friday unearthed an illegal dairy unit which was being run under the cover of ice factory and seized 20,000 litre chemical contaminated milk. A case was registered against owner of the factory.

Fake food poisoning claim holidaymaker hit with £6,000 fine after ex filmed him dancing Gangnam Style
itv Friday, June 8, 2018 9:48:00 PM CEST | info [other]
Video report by ITV News Consumer Editor Chris Choi Dancing Gangnam Style by the side of a swimming pool in Cyprus. Liam Royle appears full of life. Yet according to him, he was suffering from food poisoning he had developed while on his holiday - experiencing stomach cramps, diarrhoea and vomiting....

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Brief: Chinese police arrest 15 in fake alcohol crackdown Staff reporter FREE Papers Events

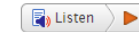


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TRENDING: PANAMA LEAKS CPEC NAQEEBULLAH KILLING MIR KHALIL-UR-RAHMAN ELECTIONS 2018



Lahore

Illegal dairy unit unearthed, spurious milk destroyed



Our Correspondent

June 9, 2018

Share



0

LAHORE: Punjab Food Authority (PFA) on Friday unearthed an illegal dairy unit which was being run under the cover of ice factory and seized 20,000 litre chemical contaminated milk. A case was registered against owner of the factory.

This was informed by PFA Director General Noorul Amin Mengal. He said the PFA caught three vehicles load of milk and the milk ready to supply to shops. He said the Authority raided

Interface: en - English

EMM Food Fraud Filter Design steps



- Updated every 10 minutes.
- 24/7
- 60 languages

- 6000 websites
- ...etc

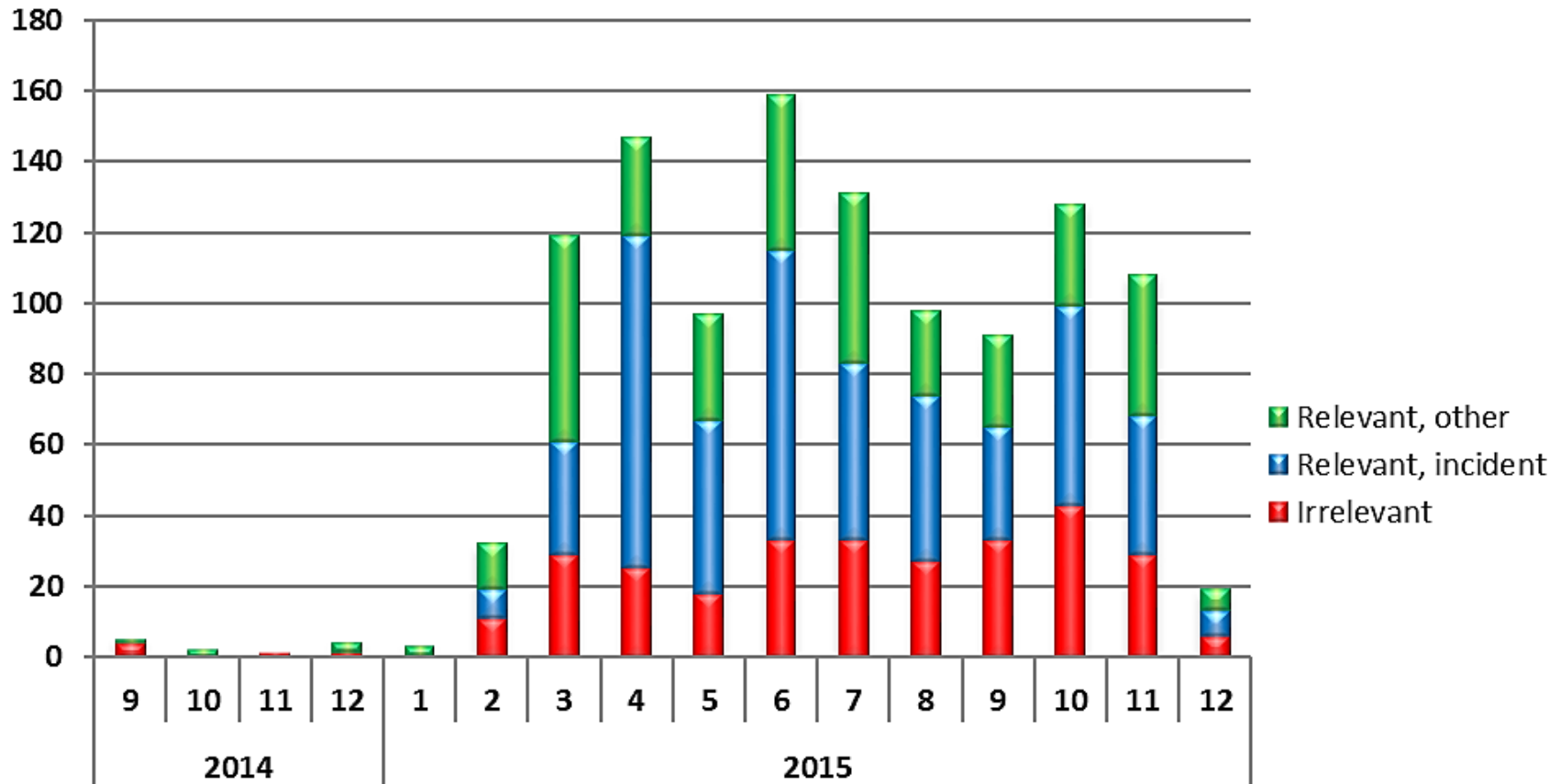
The screenshot shows the EMM MEDISYS interface. On the left, there is a sidebar with a list of categories: Top Stories, Event Extraction, Recent Disease Incidents, Alert Statistics, Communicable Diseases, Zoonoses, Bacteriology, Nuclear, Chemical, ECDC, EFSA, Other, Contaminants, Official Sources, and Sources List. The main content area is titled "Latest News About - FoodIntegrity" and displays several news articles. On the right, there is a search bar and a "Language" selection menu.

- 600 keywords.
- 8 languages.
- ...etc

- Automatic retrieval of reports
- Automatic data storage
- Automatic data processing

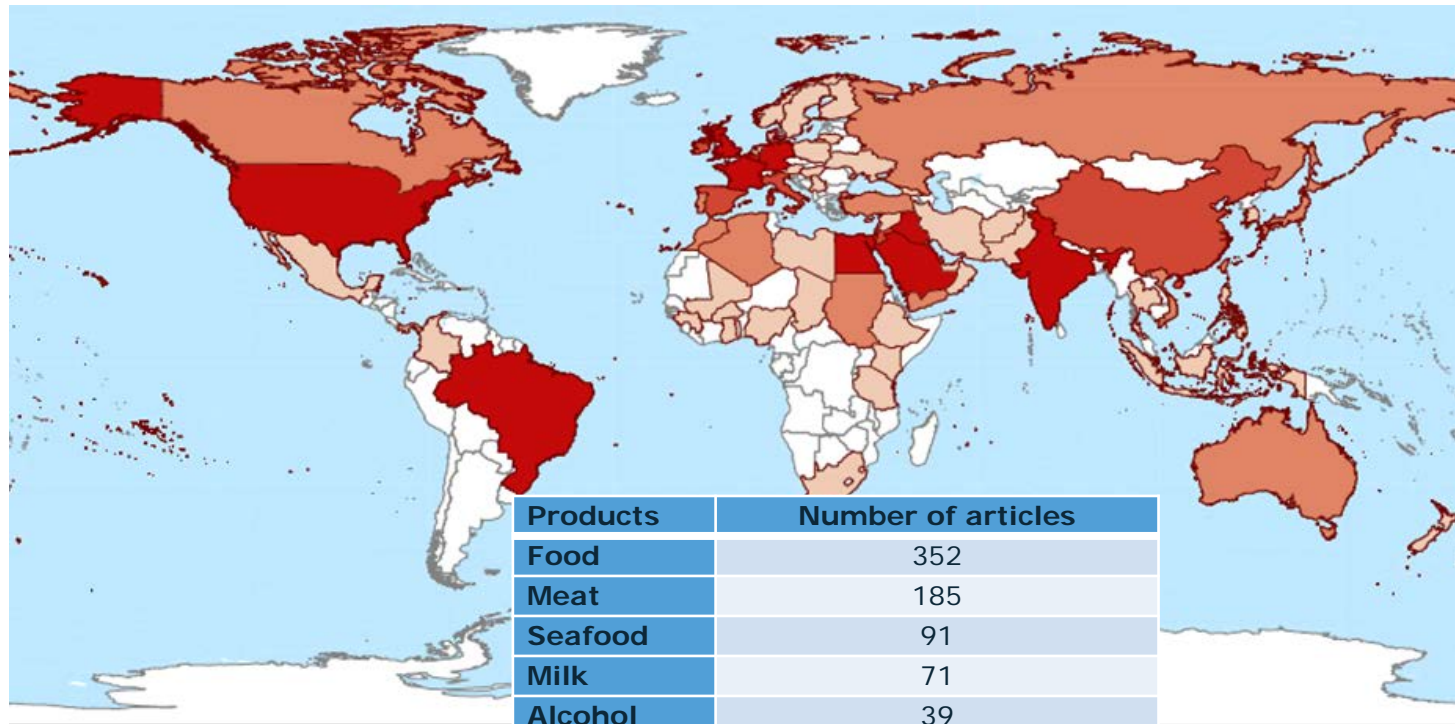


Analysis of publications from MedISys-FF



> 80% of the collected publications are relevant

Countries with media reports on food fraud (Period 2014-2015)

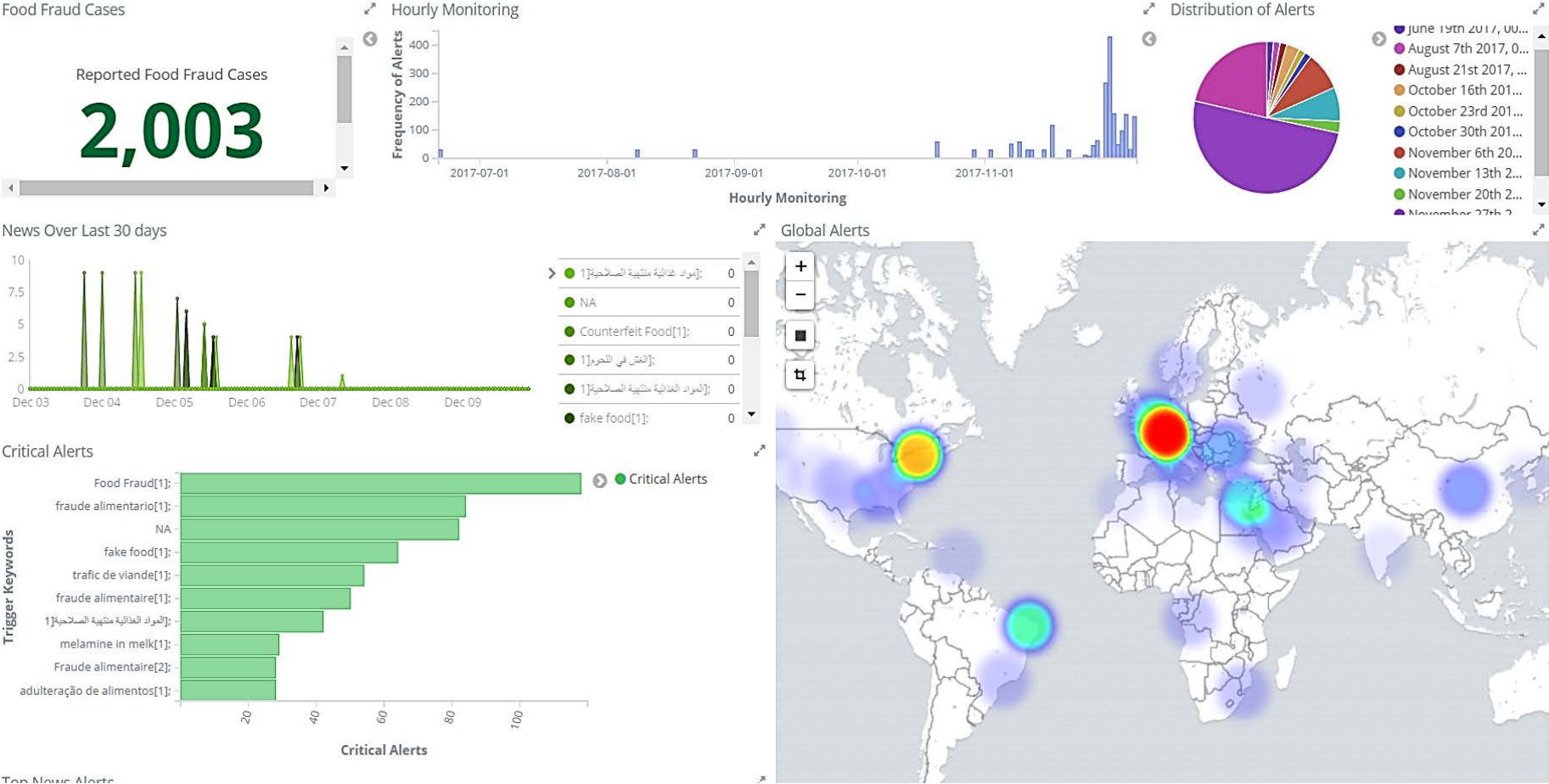


Products	Number of articles
Food	352
Meat	185
Seafood	91
Milk	71
Alcohol	39
Poultry	33
Other products	30
Cheese	16
Olive Oil	20
Honey	10
Coffee	4
Total	851

Legend

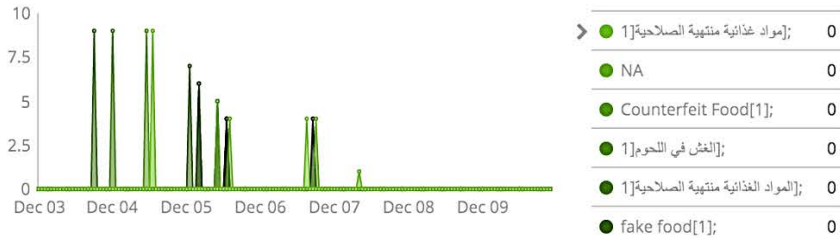
- no articles
- 1-5 articles
- 6-10 articles
- 10-25 articles
- over 25 articles with number of articles

Data visualisation in a dashboard using Kibana (1)

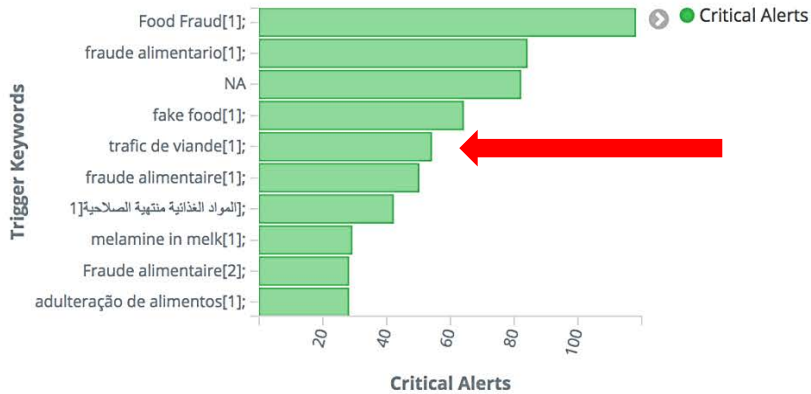


Data visualisation in a dashboard using Kibana (2)

News Over Last 30 days



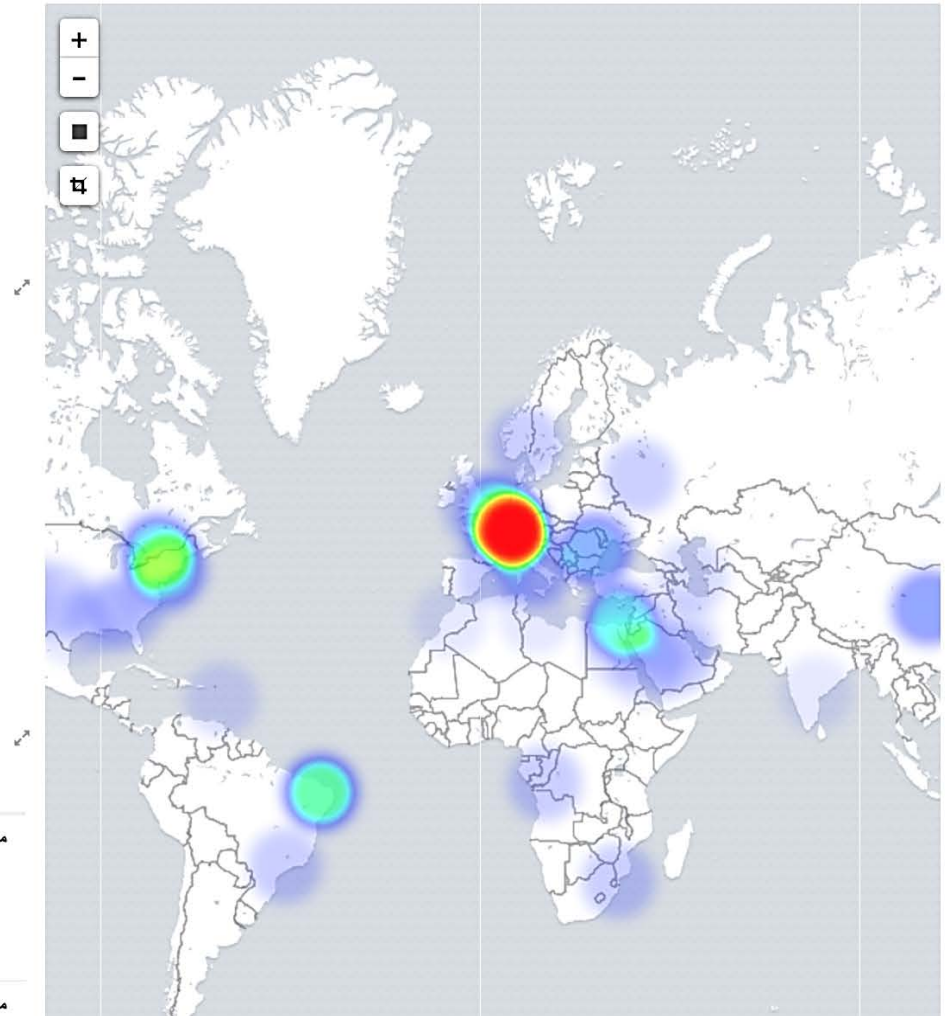
Critical Alerts



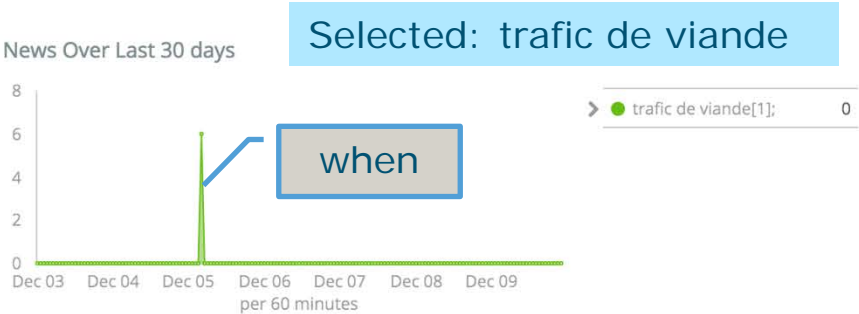
Top News Alerts

Title	Link	Trigger
محافظ قنا: ضبط 17 ألفا و 832 عبوة وقطع مواد غذائية منتهية الصلاحية	http://www.elbalad.news/3056940	مواد غذائية منتهية الصلاحية[1]; المواد الغذائية منتهية الصلاحية[1];
ضبط مواد غذائية منتهية الصلاحية في حملة	http://www.dostor.org/1651707	مواد غذائية منتهية الصلاحية[1];

Global Alerts

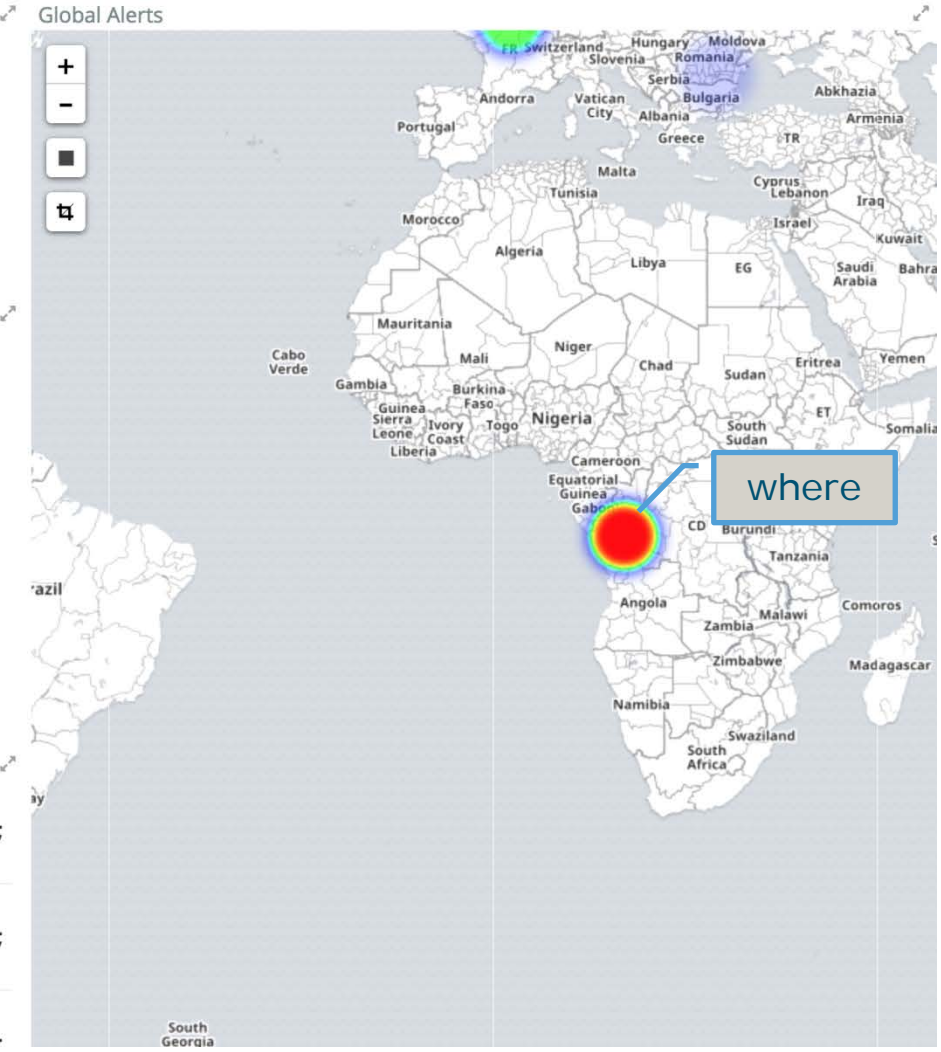


Data visualisation in a dashboard using Kibana (3)



Top News Alerts

Tendances Première : Le Dossier - Qui pour sauver les bonobos? - 10/11/2017	https://www.rtbf.be/auvio/detail_tendances-premiere-le-dossier?id=2275945	trafic de viande[1];
Le jeu d'évasion fait toujours plus d'adeptes à Nîmes	http://www.midilibre.fr/2017/11/07/le-jeu-d-evasion-fait-toujours-plus-d-adeptes-a-nimes,1584177.php#xtor=RSS-5	trafic de viande[1];
Europol démantèle un trafic européen de viande de	https://www.econostrum.info/Europol-demantele-un-traffic-europeen-de-viande-de-	trafic de viande[1];



Data visualisation in a dashboard using Kibana (3)



Food Control

Available online 2 June 2018

In Press, Accepted Manuscript — Note to users



Development of food fraud media monitoring system based on text mining.

Y. Bouzembrak¹, B. Steen¹, R. Neslo², J. Linge³, V. Mojtahed⁴, H.J.P. Marvin¹

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<https://doi.org/10.1016/j.foodcont.2018.06.003>

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Conclusions

- To address emerging risks and food fraud a system approach is needed and BNs are suitable for this
- BN model of food fraud can achieve high accuracy of prediction and may be used for scenario analysis
- MedISys-FF, as developed by RIKILT, is useful to collect publications in the media on food fraud
- Food fraud reports are collected from all continents
- MedISys-FF collects complementary information compared to RASFF, EMA and HorizonScan.

Thank you

Acknowledgement

This research was conducted in the framework of the EU FP7 project "FoodIntegrity".

We would like to thank the following RIKILT WUR colleagues:

Esmée Janssen,

Ine van der Fels Klerx, Esther van Asselt,

Gijs A. Kleter.

