Analysis of perception of infectious diseases on the internet in Poland

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HARMONY
Novel tools for test evaluation and disease prevalence estimation

Background

We are going to quantify and analyze differences in the perception of infectious diseases on the Internet dependent on host type:

- zoonotic diseases: such as COVID-19 in animal reservoirs (mainly livestock such as Minks) and Avian Influenza;
- mainly human host diseases such as COVID-19;
- animal only diseases such as ASF.

Research Problem

Nowadays researchers widely use online social media data to investigate the behavioral and affective dynamics of the public during COVID-19 pandemics. However, non-English European languages are highly underrepresented and other zoonotic diseases are not covered at all.

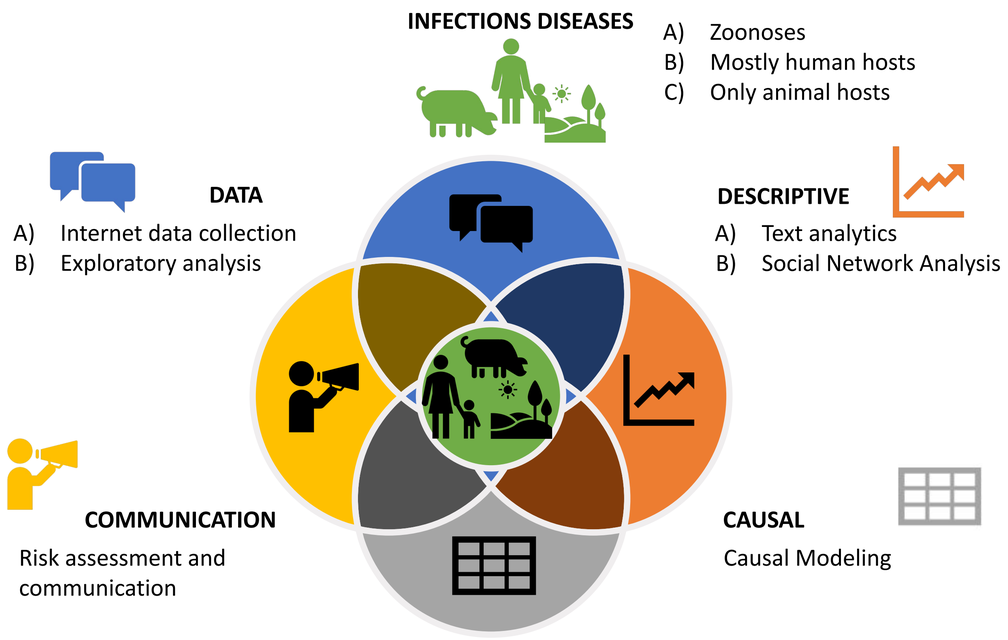


Diagram of project implementation.
Infosurvelliance in prediction/forecasting COVID-19 infection dynamics:

- worked far below expectation in Europe for publicly availabe dataset (i.e. Lampos, V et al. "Tracking COVID-19 using online search"(2021)),
- on the other hand seems to work with much more precised dataset in China (i.e. Guo, S et al. "Improving Google flu trends for COVID-19 estimates using Weibo posts."(2021)).
- High expectation, little predictive power (low digitalization rates and lack of availability of individual records in Western societies?)

Thus, this project will fill a crucial research gap by investigating and integrating major research questions among others:

- **CASE A** What is the hierarchy of social perception of infectious diseases and who are stakeholders interested in animal infections/ in zoonoses/ in human diseases?
- **CASE B** To what extent infoveillance could be used in estimating the burden of disease?

In Case Studies, we show a possibility of using infoveliance/infodemiology as an example of Google Trends, where we have measured weekly interest of a given keyword. Specificity, Sensitivity Estimation (Case A) and understating social (Case B) interest.

Outlook and Conclusions

We have just started our project, but we could already state that:

- Infodemiology **is very useful** in understanding social perception during the pandemic by quantifying dynamics of interest (demand and supply of content) and discourse patterns. It plays a supplementary role to standard tools such as surveys and allows for the analysis in real time.
- Infosurveillance **could be useful** for public health decision makers in some specific areas such as predicting disease prevalence.

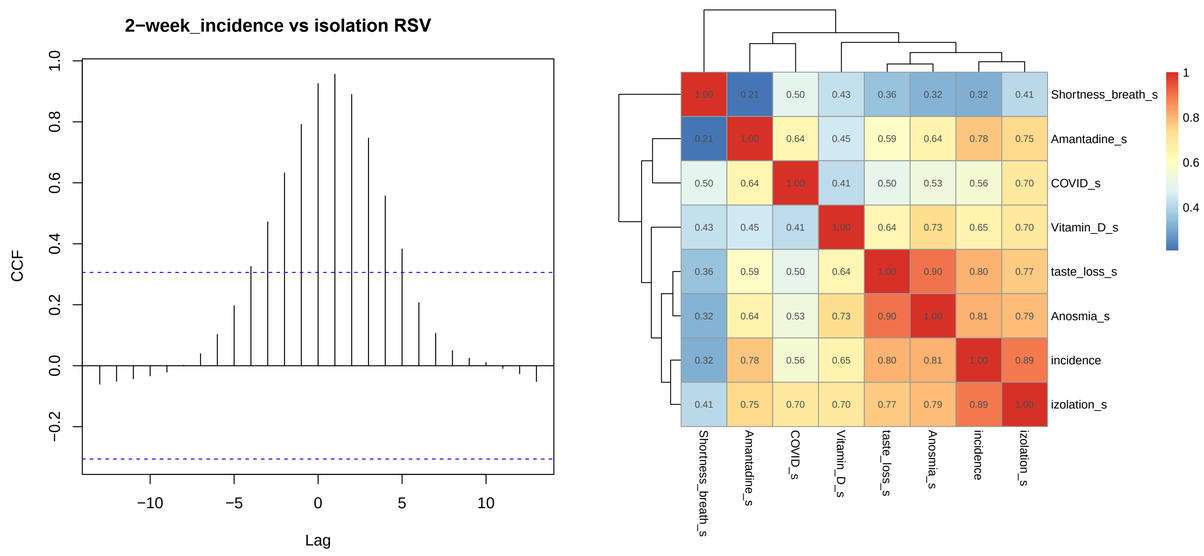
The level of interest in infectious disease differs across host type:

- humans (the highest interest among the general population with i.e. > million tweets monthly);
- zoonotic (average interest with some peak during local events as SARS-CoV-2 outbreaks among Minks or outbreak of Rabies in accompanying pets with dozens of thousands tweets monthly);
- non-zoonotic (interest only in engaged group with maximally few thousands tweets monthly).

Assuming that the 2-week cumulative incidence is not an ground truth measurement of prevalence, we managed to achieve **91% sensitivity and 98% specificity using the syndromic index for epidemic trend detection**. Moreover, keywords (syndromic or infectious disease explicitly) follows their fashion style life-cycles.

Assessment of Disease Se (Sensitivity)/Sp(Specificity)

Case study A)
Mathematical methods assessing disease prevalence based on available information are critically important to both the identification and control of pathogens in humans and animals (including zoonoses). However, prevalence estimation is extremely difficult.
We have analyzed relative search volumes (RSV from 0 to 100 for each keyword) weekly time series of chosen bag of keywords (taste loss, Anosmia, Amantadine, Shortness of breath, Vitamin D, COVID-19, isolation) as well as registered COVID-19 case notifications (since week 10 of the year 2020 till week 5 of 2022).



Left: Cross-correlations of "isolation" and 2-weekly incidence, Right: Spearman correlation matrix of weekly time series of popularity of particular phrases and 2-weekly incidence.
RSV and popularity of given keywords are highly correlated, i.e. popularity of isolation proceed incidence rates.
Thus, we build so called "Syndromic index" and compare it with countrywide 14-day cumulative infection rate (as the closest to "gold standard" of prevalence estimation in absence of sampling) for each week.
For each week our diagnostic measures (Incid: first derivative of cumulative incidence and Synd: first derivative of "Syndromic index") can take:

- + (is growing);
- - (is decreasing).

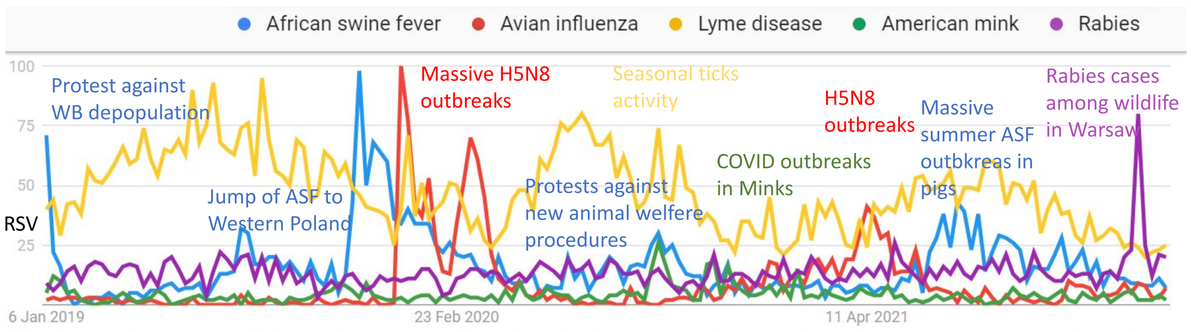
It's mean that if cumulative incidence is greater in a given than in previous week, then Incid is +, - if its smaller.
Se/Sp of "Synd:Sign of Syndromic index change" and "Incid:Sign of Incidence change" obtained using BLCM (Bayesian Latent Class Model) for given epidemic wave

wave	Incid+/Synd+	Incid+/Synd-	Incid-/Synd+	Incid-/Synd-	Se Incid	Se Synd	Sp Incid	Sp Synd
all	44	17	7	25	0.86	0.71	0.99	0.98
first&sec	17	7	7	15	0.69	0.69	0.99	0.98
third&fourth	27	2	0	41	0.96	0.91	0.99	0.98

A given choice of keywords were closer to epidemiological prevalence proxy since second wave of infections. Even ad hoc selection of keywords gives a good agreement with incidence rate, especially when the information needs in first phases of disease has been satisfied.

Assessment of disease prevalence/importance

Case study B
Interest of internet users in selected infectious diseases (RSV) usually peak up during (re-) emergence of diseases in a new region and can be also driven by social-induced events such as street protest. Seasonal patterns can be also detected.



Trajectories of individually normalized relative search queries of given keywords with related events.

Acknowledgement

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