Perception of infectious diseases with animal and humans hosts on the Polish internet

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Introduction

Timeliness and precision for infectious human/animal disease prevalence and outbreaks detection (infovelliance) and its impact on the society (Infodemiology) from data published on the web is crucial for prevention against their spread (Eysenbach, 2009; Jarynowski, 2022). Infodemiology may be very useful in understanding social perception of infectious diseases by quantifying dynamics of interest (demand and supply of content) and discourse patterns (behavioral and affective). It plays a complementary role to standard tools such as surveys and allows for the analysis in real time. There is a complex interaction landscape between animal breeders and society as well as their interaction with nature (Jarynowski et al., 2019) and will be more and more challenging (van der Ploeg, 2020; Dobbins et al., 2021). Dutch farmers took to the roads in tractors in November 2020 to protest against culling minks due to detection of a mink-associated SARS-CoV-2 variant, the so-called Cluster 5 (Dyer, 2020). The COVID-19 pandemic has dominated the socio-economic picture of the last 2 years (Jarynowski, Wójta-Kempa, 2020) almost everywhere around the world and is also speeding up research in infodemiology. Disinformation and misinformation around infectious diseases (Eysenbach, 2008) spread up propagation during the COVID-19 crisis, the World Health Organization (WHO) has stated that the world is not “just fighting an epidemic; we’re fighting an infodemic” (Eysenbach, 2020). The advent of the Internet and social networks has changed the way the world communicates, digital communities have given rise to new socio-cultural scenarios compared to the past, thus some new tools are nead that mixes the theories of the communication sciences and psychological ones with IT techniques to collect and process data. However, non-English European languages are highly underrepresented and other zoonotic diseases are hardly covered by this research. At the same time, the African Swine Fever (ASF) and Avian Influenza (HPAI) are continuing to spread, covering more and more regions, affecting the economics of animal production.

Animal epizootics show a widely destructive impact on livestock production, but also cause tensions between various groups of interest. Hence, lack of effective mitigating actions to control ASF for instance (Iacolina et al., 2021) has been deeply triggering in European regions. There were attempts to map the landscape by surveys, interviews or media perception analysis with a special focus on conflicts and protests (Gorlach, 2000) in agriculture. Pre-existing social conflicting matters of animal production. Such a structural configuration facilitates mobilization of own groups of interest and ends up with conflict between animal breeders, far-right, agricultural parties, Christian organizations as well as opposing, government, pro-European opposition and ecological organizations (Jarynowski et al., 2019; Jarynowski, Płatek, 2022). COVID-19 crisis and pressures on farmers related to economic and climate challenges cause more and more farmers to escape from animal production (Baker et al., 2022). Moreover, special operation in Ukraine during 2022 threatens supplies for fertilizers and some crops, causing increases in animal feed prices.

The model disease which affects animal hosts only is ASF, which is not only the biggest current threat to veterinary public health, but also could be important trigger of social protest of both animal breeders and wide life conservation associations from SE Asia, thought Eastern Europe till Dominican Rep (Jarynowski et al., 2022). The disease has evolved to give rise to an even more intricate situation,

reflecting a complex interaction between sanitary, economic, environmental and sociological factors in the European region (Cwynar et al., 2019) and other parts of the world. Although the virus does not cause disease in humans, the impact it has on the global economy (Stoffel et al., 2020), especially through trade and farming disruption especially in European countries (EFSA, 2020), is substantial, causing more than one billion EUR yearly losses (ter Beek, 2018; Jarynowski et al., 2020) in Europe. Moreover, ASF has societal implications as well (Chenais, 2020). It raises important ethical and animal rights issues and questions the justification of particular agricultural business models or mitigation strategies as wild boar depopulation (Bush et al., 2021).

Besides, ASF perception and attitudes could serve as a proxy indicator in the context of other societal phenomena that have the potential to polarize. In particular, the recent COVID-19 pandemic has a big impact on ASF perception and containment strategies (Standaert, 2020; Stoffel et al., 2020).

Material & Methods

We have attempted to quantify differences in the perception of infectious diseases on the Polish Internet (demand measured by Google search queries/topics occurrence in digital traditional media and supply measured by tweeting behavior from a user perspective) dependent on host type:

1) mainly human host diseases such as COVID-19;

2) zoonotic diseases: such as COVID-19 in animal reservoirs (mainly livestock such as Minks) and Lyme disease;

3) animals only host diseases such as ASF and HPAI.

The internet is a digital footprint of social activities – secondary data source. Thus, data from Twitter, internet news media, Google Trends were collected and processed. To understand how people, perceive infectious diseases and what role the traditional and social Internet media plays in it, the acquisition of this information is necessary for effective disease control policies. In particular, we analyzed Polish Google Trends, Digital Traditional Media and Twitter from 01.01.2019 to 31.07.2022, using the internet as a digital footprint of social activities – secondary data source. Google trends measures interest of a particular search query (topic) in relative search volume (RSV) - normalized from 0 to 100. Frazeo.pl service is using a broad range of sources (e.g. online news, articles, blogs) and is a large monitor of web-based Polish corpus. This tool was used to extract time series of interest in given topics in digital traditional media. Frazeo.pl corpus is used for analysis of the most frequent Polish complementary words and the associations they trigger found in the Polish digital press (Satoła-Staśkowiak, 2021).

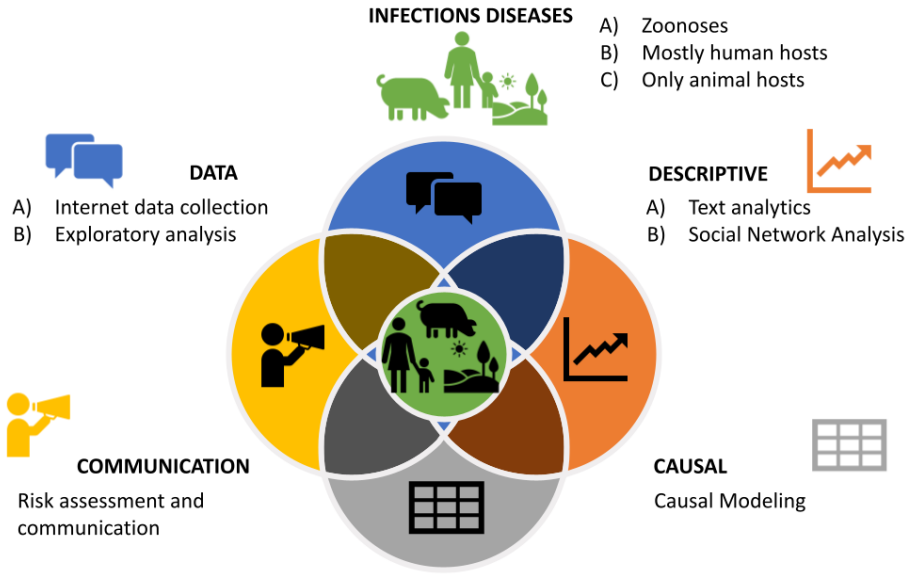

Fig. 1) Diagram of project implementation (with data and descriptive analysis already included in this preliminary research, while causal modeling and risk communication guidelines are future works)

For a model disease (ASF) we have performed additional text analysis in 2 case studies of protest triggered by the disease. We primarily applied Social Network Analysis (SNA) of the Internet media users connected via their tweets sharing activities. Nodes are Twitter accounts (after filtering), link is a retweet. Louvain algorithm for community detection was used and node color denotes the community it belongs to. Node size corresponds to frequency of occurrence in the data-set. Simple NLP (natural language processing) techniques such as sentiment analysis and keyword analysis were also applied.

A) Case Study farmers (9739 tweets between 1-31.10.2020 in Polish language with hashtag #StrajktRolników (farmers protest)). Farmers call for significant reduction of the wild boar population. In September 2020, the governing party (Law and Justice) proposed the so-called "Five for Animals" which attempted to extend animal rights, but at the same time it impacted a number of sectors of Polish agriculture (Jarynowski, Patek, 2022). Moreover, the feeling of abandonment (by the state) and powerlessness (for instance due to ongoing outbreaks of ASF and HPAI) led to protests distributed over 1000 locations across the country in October 2020.

B) Case study ecologists (5285 retweets with #ASF language also in Polish from 19.12.2018 to 18.01.2019 (animal right defenders protest)). Series of national-wide protests started January 2019 with protests against wild boar depopulation (Jarynowski et al., 2019). In turn, in several Polish cities animal right defenders organized demonstrations against hunters and government plans of wild boar depopulation as a way to slow down the spread of ASF.

Results

Interest of internet users in selected infectious diseases usually peaks up during (re-) emergence of diseases in a new region and can be also driven by social-induced events such as street protests (e.g. against ASF control strategies or due to lack of government support in infectious disease managements).

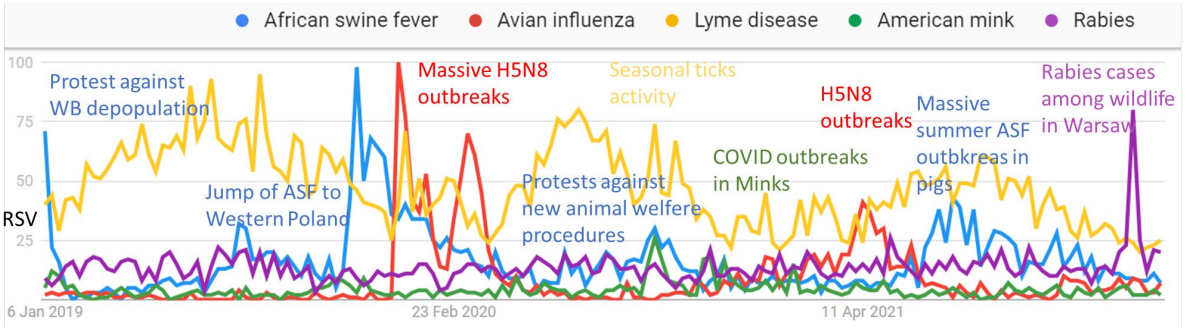

Fig. 2) Trajectories of relative search queries (weekly) of given keywords with related events (collected using https://trends.google.com/)

Seasonal patterns can be clearly detected. E.g. ASF gains the highest interest during summers, Lyme disease during springs, and HPAI during winters [Fig. 2, 4, 5].

Fig. 3) Interest by sub-region on Google Trend (darker - more interest): ASF (left), Farmer Protests (center) and Rabies (right) (collected using https://trends.google.com/)

Although infoveillance does not represent the next frontier of infectious disease prevalence estimation as it was expected (Eysenbach, 2009; Jarynowski, Wójta-Kempa, 2020; Jarynowski, 2022), in the case of Rabies the interest overlaps with surveillance [Fig. 3] geographically (Masovia is the most affected region). Moroever, COVID-19 pandemic demonstrated that biological paradigms where the interactions are described in purely biological terms, have some limits (Jarynowski, Wójta-Kempa, Belik, 2020; Jarynowski, 2022). In particular, actions of human actors, participating in the disease transmission process, such as farmers or pet owners, are driven by social dynamics (Broz, et al., 2020).

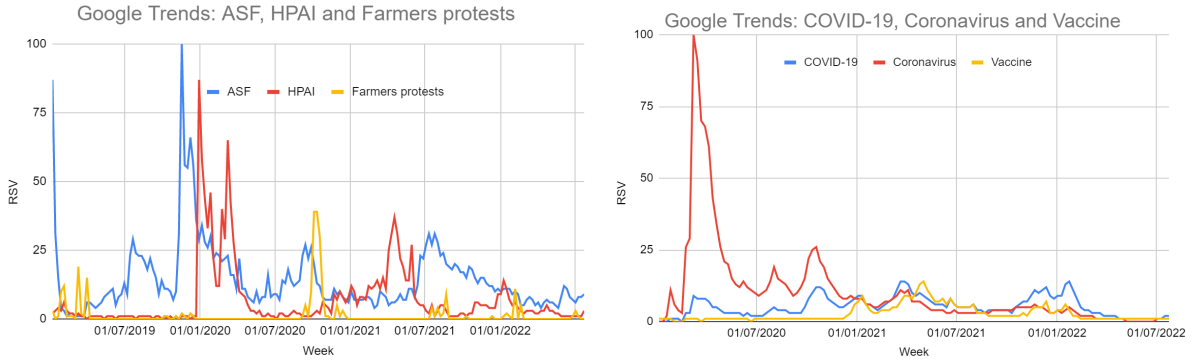

Fig. 4) Trajectories of relative search queries: RSV (weekly) of given keywords (collected using https://trends.google.com/) Please note that 100 is maximum separately for both left and right graphs thus maximum of interest in Coronavirus (right) is different (over 3 magnitude higher in fact) than for ASF (left)

Digital traditional media has been also already used in infection control (Arsevska, et al., 2016) for the early detection, assessment, and monitoring of current infectious disease threats to some extent.

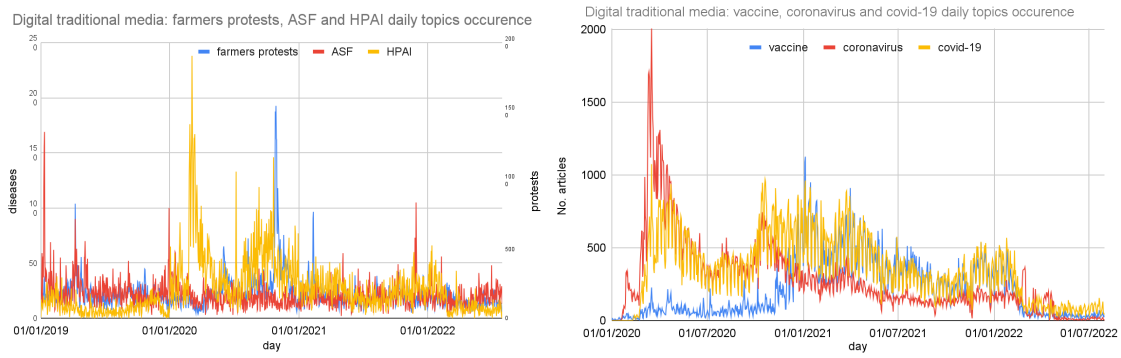

Fig. 5) Trajectories of number of news/articles (daily) with given keywords in Polish traditional digital news media (collected using http://frazeo.pl)

It worth to mention that discrepancy between new media (Google Trends [Fig. 4]) and digital traditional media [Fig. 5] can be driven by multiple factors. For instance, the narration on traditional media does not need to correspond to people information needs. Thus, we can see multiple and constant information campaigns on ASF and HPAI in digital traditional media [Fig. 5], however it does not resonate on new media as human diseases.

Tab. 1) Summary interest across selected terms (disease) and medium (areas under curves Fig. 4, 5)

term(topic)/summary interest	weekly RSV Google Search (01.2020-07.2022)	daily No. article (01.2020-07.2022)
COVID-19	713	330390
Coronavirus	1368	255620
HPAI	2.2	29857
ASF	3.3	17893

There is over 621-fold higher interest during pandemic years in Coronavirus than HPAI topics in Google trends and only 8 folds higher among news articles [Tab. 1].

Summarizing our preliminary results of interest time series:

1) The highest interest is observed in mostly human host diseases among the general population with over million tweets and hundred million search queries monthly (for instance COVID-19 in peak time (Jarynowski, 2020)). The peak of interest was in the march 2020 [Fig. 5], when restrictions were announced (Jarynowski, Wójta-Kempa, Belik, 2020).

2) Interest in zoonotic diseases is usually concentrated in selected areas [Fig. 3]. E.g. an average interest with some peaks during local events as SARS-CoV-2 outbreaks among Minks or cases of Rabies in companion animals with around million search queries monthly.

3) On the other hand, the interest in non-zoonotic diseases (animal only host) is observed only in engaged groups, such as farmers, gamekeepers, ecologists, hunters, veterinarians, public administration with few thousand tweets (Jarynowski et al., 2019; Jarynowski, Płatek, 2022) and less than million search queries monthly. Interest is concentrated in selected areas (i.e. in Greater Poland where the hub of pigs' production is, there is 5 hold higher interest in ASF than in Lesser Poland on

Google Trends [Fig. 3]). However, high presence of ASF and HPAI in digital traditional media [Fig. 5, Tab. 1] suggest that awareness campaigns have been performed, even its effectiveness can be questionable due to low reach in a general population.

In the second part of our exploratory study, we also process tweets to illustrate public attitudes towards ASF during protests.

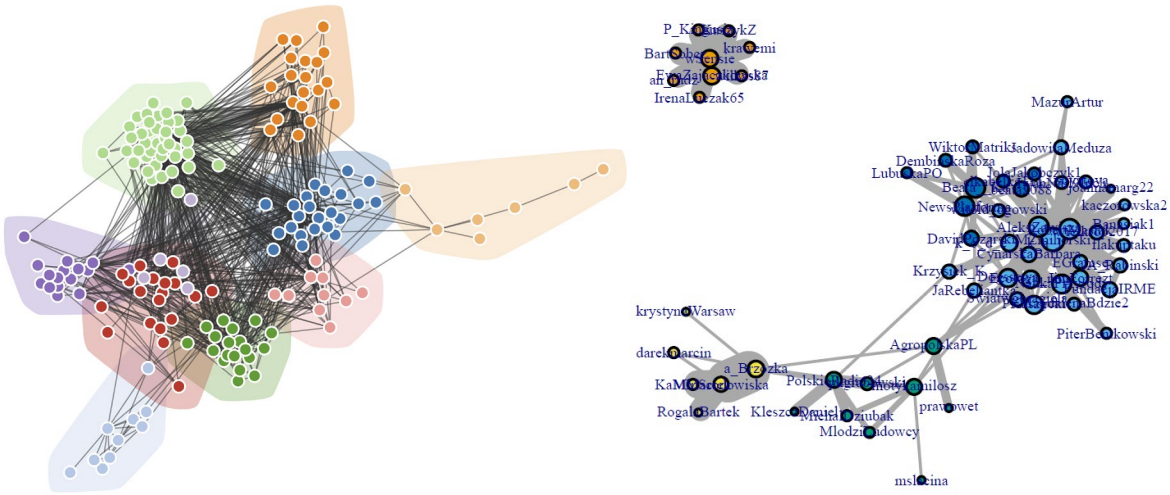

Fig. 6) Networks of Twitter users (vertices) and edges representing retweets with tagged language Polish in ASF context (collected using https://developer.twitter.com/en/docs/twitter-api) [Left] Retweeting network (only user with more than 10 retweets are shown) for hashtag farmers protest (case A) in October 2020 (http://belik.userpage.fu-berlin.de/asf/asf_vis.html). Colorcode: pink – opponents of protests from the opposition; blue – opponents of protest associated with PiS – a governing party; orange – a mix of supporters and opponents of protest; light blue/gray – Protestant protesters; red – protesting farmers and agricultural organizations; light green – supporters of protests within right-wing (conservative) organizations; violet – supporters of protests within right-wing (liberal) organizations; dark green– supporters of protests associated with agricultultural party PSL. [Right] Retweeting network for animal right defenders protest (case B) from 19.12.2018 to 18.01.2019. Colorcode: orange – right wing politicians, blue – mass media, yellow – animal rights activists, green – farmers representatives.

Let us compare two types of discussion triggered by ASF [Fig. 6], among A) farmers (Jarynowski, Płatek, 2022) and B) animal right defenders (Jarynowski et al., 2019).

A) Animal breeders' protest communication has a highly modular and hierarchical structure with farmers as a general component, but with clear boundaries between internet communities and opinion leaders. There was only a small presence of the general public (i.e. mainstream media) in the discourse. Level of optimism (text sentiment) among farmers protesters than animal right defender protesters was significantly higher than - probably due to a feeling of unity.

B) Ecological protests have been massively discussed by mainstream media and the general population constitute a general component linked closely to ecological activists' clusters. Level of verbal aggression was greater among animal right defenders' than farmers, which suggests that language repertoires differ.

Discussion

There is totally different perception in human than animal diseases: almost 100-1000-fold [Tab. 1] higher interest (i.e. No. articles/No. search daily/ No. tweets). There are no technical reasons (according to distinguished veterinarians) why animal diseases (such as ASF, even causing massive financial implications), should catch the interest of the public and become newsworthy, because the main reason is making people sick or killing, so only if animal disease has a zoonotic potential it may gain popularity in a general population (Bush et al., 2021; Trotta et al., 2022). However, not only COVID-19, but animal infectious diseases (mainly ASF and HPAI) are currently the major problems in animal breeding immediately affecting the food production market. We observed social and economic impacts of animal infection, and these diseases amplify tensions contributing to the vulnerability of some groups as farmers. E.g. the average price of hog's body mass (0.75EUR/kg) in Poland (Jarynowski et al., 2021) in the middle of Autumn 2020 was the lowest in the history of exchange markets, far below production cost (see protest in October 2020 [Fig. 3, 4, 5]). The European Green Deal is projected to affect livestock production by decline between 5% and 15%, with the animal breeder's income being the hardest hit among all farmers in the perspective of the next 10 years (Barreiro Hurle et al., 2021). Thus, social tensions (ecologists and animal breeders protests) propagate from East to West of Europe with ASF. We see in June/July 2022 that animal breeders and supply chain cooperators took to the streets all over the Netherlands (due to planned 25% cattle and milking farms reduction). This brings us closer to answering a question: how attitudes towards infectious disease in One Health paradigm are influenced by psychosocial, sociolinguistic, cultural profiles and social interaction patterns? Thus, real time monitoring of internet media as suggested in this study should be a core element of preventing spread of human, wildlife and livestock infectious diseases.

Acknowledgement & Funding

AJ and VB acknowledge financial support by DFG 458528774

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