DOI: 10.1002/jmv.28401

LETTER TO THE EDITOR

JOURNAL OF MEDICAL VIROLOGY WILEY

Impact of the COVID-19 pandemic on the circulation of other pathogens in England

Dear Editor,

Previous studies suggested that nonpharmaceutical interventions during the COVID-19 pandemic have also affected the spread of other pathogens.[1,2] Here, we analyzed the transmission patterns of 22 infectious diseases in England in the context of the COVID-19 prevention measures, using data derived from the UK Health Security Agency, the UK Office for National Statistics, and the Royal College of General Practitioners Research and Surveillance Centre (Suppporting Information: Methods and Tables 1 and 2).

Reported cases for all investigated infectious diseases dipped in response to the first lockdown except from methicillin-resistant *Staphylococcus aureus* (MRSA), Lyme disease, and hepatitis E (Figure 1 and Supporting Information: Figures 1–22). MRSA infections are usually diagnosed in healthcare settings,[3] and some studies reported an increase of MRSA cases during COVID-19.[3] Hepatitis E is predominantly transmitted by contaminated food in England, in particular from farmed pigs.[4] Therefore, these finding do not seem to be surprising.

Lyme disease was not reduced during the initial lockdown but a decrease has been reported later in the pandemic (Figure 1 and Supporting Information: Figure 22), which is probably attributed to underreporting.[5] Generally, the drop in documented cases during the first lockdown is difficult to interpret, as it might be the consequence of underreporting.[5,6]

Thirteen diseases displayed a sustained reduction when prevention measures were in place (Figure 1 and Supporting Information: Figures 1–22), including 9 of the 10 diseases that spread via the air and 4 of the 6 diseases characterized by fecal–oral transmission (Figure 1 and Supporting Information: Figures 1–10 and 16–21).

The prevention measure-associated associated reduction of airborne pathogens confirms other findings.[2,7] The only exception was tuberculosis (Figure 1 and Supporting Information: Figure 9). Most tuberculosis infections are asymptomatic and go undiagnosed.[8,9] Delayed diagnoses due to limited access to tuberculosis services during the pandemic may have caused a rise of severe cases, including COVID-19/tuberculosis co-infections.[9,10] Hence, the pandemic measures may not have reduced severe tuberculosis cases, which are typically diagnosed.

Moreover, our findings agree with others showing that hygiene measures and physical distancing reduce the transmission of enteric diseases that are transmitted via the fecal–oral route.[1,6,7] Exceptions may indicate pathogens that are predominantly spread by food contaminations without significant further human-to-human transmission.[4] Also in agreement with previous findings,[2] the pandemic-related prevention measures disrupted the seasonal transmission patterns of different infectious diseases (Figure 1 and Supporting Information: Figures 1, 2, 6, 7 and 20).

There are concerns that the disruption of routine vaccinations may affect population immunity resulting in larger outbreaks of vaccine-preventable diseases.[2] However, our findings indicate a sustainable suppression of vaccine-preventable diseases also beyond the lifting of restrictions (Figure 1). This included measles, mumps, rubella, pertussis, and pneumococcal disease (Supporting Information: Figures 3–6 and 10). Although our data also indicate a sustained reduction of influenza-like illnesses, other data suggest that influenza cases should be expected to rebound.[11] This may reflect the relatively low influenza vaccination rates and influenza vaccine efficacy compared to other vaccine-preventable diseases.[10]

By contrast, non-vaccine preventable respiratory infections including chickenpox (not part of routine vaccinations in the UK), scarlet fever, and streptococcal pharyngitis displayed an immediate resurgence after the removal of prevention measures (Supporting Information: Figures 1, 7 and 8), suggesting that similar transmission peaks have been prevented by the vaccine-mediated immunity for the diseases with high vaccine coverage in the UK.

Concerns have been raised that a lack of exposure to common pathogens may result in decreased immunity enabling larger and more deleterious outbreaks.[2] However, only four infectious diseases (chickenpox, herpes simplex virus, skin and subcutaneous tissue infections, infectious intestinal diseases) have since the removal of all restrictions in England on July 19, 2021 resulted in higher spread levels than pre-COVID-19 (Figure 1). It remains to be investigated whether these increases may be related to COVID-19.

In conclusion, our analysis shows that the COVID-19 prevention measures reduced the spread of pathogens that are transmitted via the air and the fecal–oral route. Despite concerns that a lack of exposure to common pathogens may affect population immunity and result in large outbreaks by various pathogens post-COVID-19, only 4 of the 22 investigated diseases and disease groups displayed higher post- than prepandemic levels without an obvious causative relationship. This included chickenpox for which an effective vaccine is available but not used in the UK. Notably, the COVID-19 prevention measures resulted in the sustained suppression of

	Transmission	Vaccine	Sustained suppression	Resurgence	Compared to Pre-COVID-19	Seasonal patterns
Chickenpox	Airborne/ droplet	Yes*	Yes	Yes	Higher	Disrupted
Influenza-like illnesses	Airborne/ droplet	Yes**	Yes	Unclear	Lower	Disrupted
Measles	Airborne/ droplet	Yes	Yes	No	Lower	Not applicable
Mumps	Airborne/ droplet	Yes	Yes	No	Lower	Not applicable
Rubella	Airborne/ droplet	Yes	Yes	No	Lower	Not applicable
Pneumococcal disease	Airborne/ droplet	Yes	Yes	Yes	Lower	Disrupted
Scarlet fever	Airborne/ droplet	No	Yes	Yes	Comparable	Disrupted
Streptococcal pharyngitis/ strep throat	Airborne/ droplet	No	Yes	Yes	Comparable to lower	Potentially disrupted
Tuberculosis	Airborne/ droplet	No	No	No	Comparable	Not applicable
Pertussis/ whooping cough	Airborne/ droplet	Yes	Yes	No	Lower	Not applicable
Hepatitis C	Blood-borne	No	No	No	Comparable	Not applicable
Herpes simplex virus	Direct contact	No	No	No	Higher	Not applicable
Methicillin-resistant Staphylococcus aureus	Direct contact	No	No	No	Comparable	Not applicable
Skin and Subcutaneous Tissue Infections	Direct contact	No	No	No	Higher	Not applicable
Urinary tract infections	Direct contact	No	No	No	Comparable	Not applicable
Cryptosporidiosis	Faecal-oral	No	Yes	No	Comparable	Unaffected
Foodborne illness	Faecal-oral	No	Yes	No	Lower	Unaffected
Hepatitis E	Faecal-oral	No	No	No	Comparable	Not applicable
Infectious Intestinal Diseases	Faecal-oral	No	No	No	Higher	Not applicable
Norovirus	Faecal-oral	No	Yes	Yes	Comparable	Disrupted
Shigellosis	Faecal-oral	No	Yes	Yes	Comparable	Not applicable
Lyme disease	Vector	No	Yes	Unclear	Lower	Unaffected

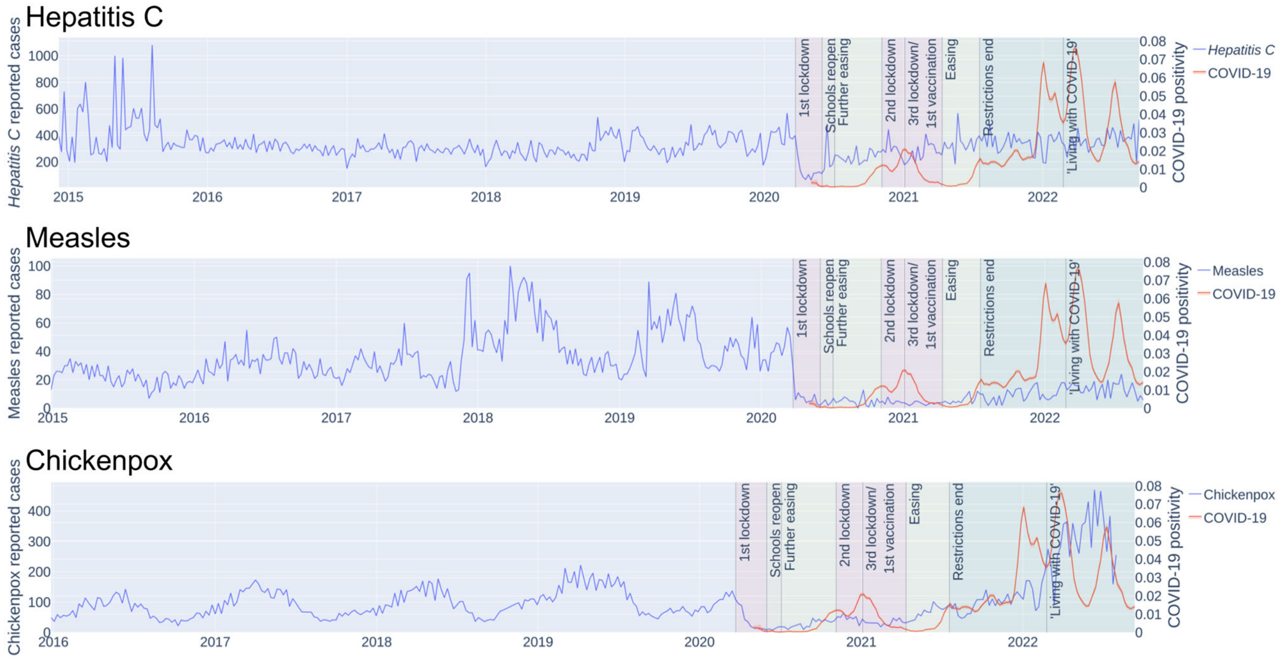

FIGURE 1 Impact of COVID-19 prevention measures on the circulation of other infectious diseases. Overview table providing a qualitative description of the impact of the COVID-19 measures on the investigated pathogens in England and curves illustrating the impact of the COVID-19 measures on hepatitis C, measles, and chickenpox. A detailed information is presented in Supporting Information: Figures 1–22.

vaccine-preventable infectious diseases also after the removal of restrictions, while non-vaccine preventable diseases displayed a rapid rebound, supporting the importance of effective vaccination programmes. More research investigating how disease burden can be reduced by tolerable non-pharmaceutical interventions is warranted.

AUTHOR CONTRIBUTIONS

Lauren J. Hayes and Martin Michaelis developed the project idea. Lauren J. Hayes and Hannah Uri performed the research. Mark N. Wass and Martin Michaelis supervised the research. All authors analyzed data. Martin Michaelis wrote the initial manuscript draft. All authors contributed to the finalization of the manuscript. All authors approved the final version of the manuscript.

ACKNOWLEDGMENTS

This work was supported by the BBSRC via the SoCoBio DTP and the Frankfurter Stiftung für krebskranke Kinder.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

All data are provided in the manuscript and its supplements.

Lauren J. Hayes[1]
Hannah Uri[1]
Denisa Bojkova[2]
Jindrich CinatlJr.[2,3]
Mark N. Wass[1]
Martin Michaelis[1]

[1]*School of Biosciences, University of Kent, Canterbury, UK*
[2]*Institute for Medical Virology, University Hospital, Goethe University, Frankfurt am Main, Germany*
[3]*Dr. Petra Joh-Forschungshaus, Frankfurt am Main, Germany*

Correspondence
Mark N. Wass and Martin Michaelis, School of Biosciences, University of Kent, Canterbury CT2 7NJ, UK.
Email: M.N.Wass@kent.ac.uk and M.Michaelis@kent.ac.uk

Lauren J. Hayes and Hannah Uri contributed equally.

ORCID

Martin Michaelis http://orcid.org/0000-0002-5710-5888

REFERENCES

1. Eldesouki RE, Uhteg K, Mostafa HH. The circulation of non-SARS-CoV-2 respiratory viruses and coinfections with SARS-CoV-2 during the surge of the Omicron variant. *J Clin Virol*. 2022;153:105215.
2. Oh KB, Doherty TM, Vetter V, Bonanni P. Lifting non-pharmaceutical interventions following the COVID-19 pandemic—the quiet before the storm? *Expert Rev Vaccines*. 2022;21:1541-1553. doi:10.1080/14760584.2022.2117693
3. Segala FV, Bavaro DF, Di Gennaro F, et al. Impact of SARS-CoV-2 epidemic on antimicrobial resistance: a literature review. *Viruses*. 2021;13:2110.
4. Oeser C, Vaughan A, Said B, et al. Epidemiology of hepatitis E in England and Wales: a 10-year retrospective surveillance study, 2008-2017. *J Infect Dis*. 2019;220:802-810.
5. McCormick DW, Kugeler KJ, Marx GE, et al. Effects of COVID-19 pandemic on reported Lyme disease, United States, 2020. *Emerging Infect Dis*. 2021;27:2715-2717.
6. Kim S, Kim J, Choi BY, Park B. Trends in gastrointestinal infections before and during non-pharmaceutical interventions in Korea in comparison with the United States. *Epidemiol Health*. 2022;44:e2022011.
7. Nielsen RT, Dalby T, Emborg HD, et al. COVID-19 preventive measures coincided with a marked decline in other infectious diseases in Denmark, spring 2020. *Epidemiol Infect*. 2022;150:e138.
8. Boom WH, Schaible UE, Achkar JM. The knowns and unknowns of latent Mycobacterium tuberculosis infection. *J Clin Invest*. 2021;131:e136222.
9. Trajman A, Felker I, Alves LC, et al. The COVID-19 and TB syndemic: the way forward. *Int J Tuberc Lung Dis*. 2022;26:710-719.
10. Wang Q, Guo S, Wei X, et al. Global prevalence, treatment and outcome of tuberculosis and COVID-19 coinfection: a systematic review and meta-analysis (from November 2019 to March 2021). *BMJ Open*. 2022;12:e059396.
11. Pérez-López A, Al Mana H, Iqbal M, Suleiman M, Hasan MR, Tang P. Resurgence of influenza A infections in children after the relaxation of COVID-19-related social distancing measures and normalization of international travel in Qatar. *J Travel Med*. 2022:taac107. doi:10.1093/jtm/taac107
12. Uyeki TM, Hui DS, Zambon M, Wentworth DE, Monto AS. Influenza. *Lancet*. 2022;400:693-706.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.