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COVID-19 impact on EuroTravNet infectious diseases sentinel surveillance in Europe

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ABSTRACT

Background: The COVID-19 pandemic resulted in a sharp decline of post-travel patient encounters at the European sentinel surveillance network (EuroTravNet) of travellers' health. We report on the impact of COVID-19 on travel-related infectious diseases as recorded by EuroTravNet clinics.

Methods: Travelers who presented between January 1, 2019 and September 30, 2021 were included. Comparisons were made between the pre-pandemic period (14 months from January 1, 2019 to February 29, 2020); and the pandemic period (19 months from March 1, 2020 to September 30, 2021).

Results: Of the 15,124 visits to the network during the 33-month observation period, 10,941 (72%) were during the pre-pandemic period, and 4183 (28%) during the pandemic period. Average monthly visits declined from 782/month (pre-COVID-19 era) to 220/month (COVID-19 pandemic era). Among non-migrants, the top-10 countries of exposure changed after onset of the COVID-19 pandemic; destinations such as Italy and Austria, where COVID-19 exposure peaked in the first months, replaced typical travel destinations in Asia (Thailand, Indonesia, India). There was a small decline in migrant patients reported, with little change in the top countries of exposure (Bolivia, Mali).

The three top diagnoses with the largest overall decreases in relative frequency were acute gastroenteritis (−5.3%), rabies post-exposure prophylaxis (−2.8%), and dengue (−2.6%). Apart from COVID-19 (which rose from 0.1% to 12.7%), the three top diagnoses with the largest overall relative frequency increase were schistosomiasis (+4.9%), strongyloidiasis (+2.7%), and latent tuberculosis (+2.4%).

Conclusions: A marked COVID-19 pandemic-induced decline in global travel activities is reflected in reduced travel-related infectious diseases sentinel surveillance reporting.

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1. Background

Worldwide, up to mid-April 2023, about 676 million confirmed cases and almost 6.9 million deaths have been officially documented since the beginning of the COVID-19 pandemic according to one [1] of several global COVID-19 pandemic tracking systems [2]. The pandemic had a significant negative impact on international travel.

According to the United Nations World Tourism Organization (UNWTO) [3], international tourist arrivals worldwide declined by a mean of 72% in 2020 (73%) and 2021 (71%), as compared to 2019; with trends towards recovery during 2022. Not surprisingly, this trend was reflected in the declining numbers of travellers seeking pre-travel advice at health facilities worldwide. During the pandemic and peri-pandemic periods, most travellers needed airline and entry requirement information, available online from government and public health authorities, rather than traditional pre-travel, general health advice. There was also a major decline in ill-returning travellers, for various types of travel, including tourism, business, visiting friends and relatives in the country of origin after emigration (VFR), and migrants [4]. EuroTravNet [5], the European part of GeoSentinel [6], the global emerging infectious diseases surveillance and research network of the International Society of Travel Medicine (ISTM), recorded increasing numbers of post-travel patient encounters over the past 20 years [7], with a sharp decline at onset of the COVID-19 pandemic in early 2020. We report here on the impact of COVID-19 on the EuroTravNet sentinel surveillance.

2. Methods

Detailed patient recruitment methods, inclusion criteria, diagnostic tests and limitations of the EuroTravNet [5] and GeoSentinel [6] databases have been described elsewhere. In brief, data records can be entered in the database, for patients who sought medical care for presumed travel-related illnesses or screening for asymptomatic infections, and if they crossed an international border within the last 12 months before the clinic visit. All travellers presenting with relevant diagnoses to one of the 23 data-contributing EuroTravNet sites are included in the GeoSentinel database. Etiologic and syndromic diagnoses are coded and harmonised across sites using a common set of specified clinical and/or laboratory definitions. Syndromic codes are used when a clinical diagnosis is made, and no specific pathogen is identified. The data collection protocol is classified as public health surveillance and not human subjects research, by the institutional review board officer at the United States National Center for Emerging and Zoonotic Infectious Diseases, at the Centers for Disease Control and Prevention (CDC).

Travellers who presented to EuroTravNet sites with a presumed travel-related diagnosis during the total study period of 33 months between January 1st, 2019 and September 30th, 2021 were included. Unlike other analyses based on the same database, records of patients who were asymptomatic and did not have a final diagnostic code assigned, or whose final diagnosis was only suspected, were also included.

Comparisons were made between the pre-pandemic period (14 months from January 1, 2019 to February 29, 2020); and the pandemic period (19 months from March 1, 2020 to September 30, 2021). Where appropriate, we further differentiated between an early (ten months from March 1, 2020 to December 31, 2020) and a later pandemic phase (nine months from January 1, 2021 to September 30, 2021). Because analyses are based on monthly rather than daily summaries, and different clinics experienced the onset of the pandemic over different dates, the pre-pandemic cut-point was set for March 1st, 2020.

The type of travel is divided into five categories; (1) leisure travel including tourism and retirement; (2) all types of VFR travel; (3) travel for immigration or as a migrant worker; (4) travel for work-related/professional reasons including providing medical care, attending conferences, military, study abroad, for research; and (5) any other travel reasons or missing travel reason.

Because there was a marked drop in the number of ill-returned travellers seeking care at EuroTravNet sites after March 2020, comparisons of the diagnoses before and after are relative to changes in other diagnoses. The number of reports of each diagnosis in a time period as a percentage of all diagnoses during that time period are compared between time periods. Data were analysed using Stata 17.0 for Windows (StataCorp LP, College Station, TX, USA).

3. Results

Of 15,124 visits to the network during the 33 months observation period, 10,941 (72%) were recorded during the 14-month pre-pandemic period; and 4183 (28%) during the 19-month pandemic period. Average monthly visits went from 782 per month in the pre-COVID-19 era to 220 per month during the COVID-19 pandemic observation period reported here (28.2% of pre-pandemic level; Fig. 1a; N = 15,124). Fig. 1b shows the respective individual subgroup data per month over time (N = 14,313) for leisure travellers (n = 6916), business and occupational travellers (n = 2099), people visiting relatives and friends (VFR; n = 2110), and migrants (n = 3188) This figure is not shown for 811 patients (530 patients with missing data on types of travel, 252 reported as 'other travel reasons' and 29 who travelled for planned medical care). Fig. 1c visualises the percentage of visits by travellers' category (n = 14,313).

During the study period, 649 (4.3%) patients were diagnosed with COVID-19, the majority (384 or 59%) in March 2020. The first reports of COVID-19 cases within the network were reported on 1 March (Paris) and 2 March (Stockholm) (Fig. 2a and b). A first peak of COVID-19 case reporting occurred early in the course of the pandemic, and temporarily constituted almost 50% of all monthly diagnoses in leisure travellers, and almost 60% amongst migrants in April 2020. During the first pandemic period from March 2020–Dec 2020, COVID-19 exposures were predominantly from Western Europe (79%), particularly Italy (50%), Austria (9%), UK (6%), and France (6%). During the second pandemic period, from 2021 onwards, only 18% were from Western Europe, whereas 63% of COVID-19 exposures occurred in sub-Saharan Africa (26%), South Central Asia (22%) and the Middle East (15%).

By 2021, within the EuroTravNet realm, most patients with COVID-19 diagnoses acquired the infection in subtropical and tropical regions, often with region-specific infectious diseases conditions featuring highly on the list of differential diagnoses (for example; not infrequently, patients primarily having been suspected of having malaria would turn out to be COVID-19-positive instead; but also vice versa; as well as in combination). Nine deaths were encountered during the study period; of which three before the COVID-19 pandemic onset; and six during the COVID-19 pandemic observation period, of which three (of which two males/one female; mean age 67 years) died from COVID-19, one died from COVID-19 with exposure locally and pre-existing strongyloides hyperinfection syndrome from Ecuador and one from influenza A with complicating pneumonia (Supplementary Table 1).

Table 1a, b shows the average number of patients reported per month for the top-10 countries of likely exposure during the 14-month pre-pandemic period, in the immediate early pandemic phase (10 months from March 2020 onwards), and later on (9 months from January 2021 onwards) separately for migrants and for non-migrant travellers. Fig. 3a and b illustrates the change in proportion of patients exposed by country between the pre-pandemic period to the period immediate after onset (Fig. 3a); and the subsequent change later in the course of the pandemic (Fig. 3b).

There were massive shifts in the non-migrant patient population encountered across EuroTravNet sites and although there were drops in the numbers of ill migrants reported, they came from similar countries as pre-pandemic. The UNWTO shows similar massive drops in tourist arrivals for Thailand, Indonesia, and India; while Supplementary Table 2 gives a summary of inbound tourist arrivals to a select group of countries pre-pandemic and in 2020 and 2019.

Table 2 details the major diagnoses and their relative changes over

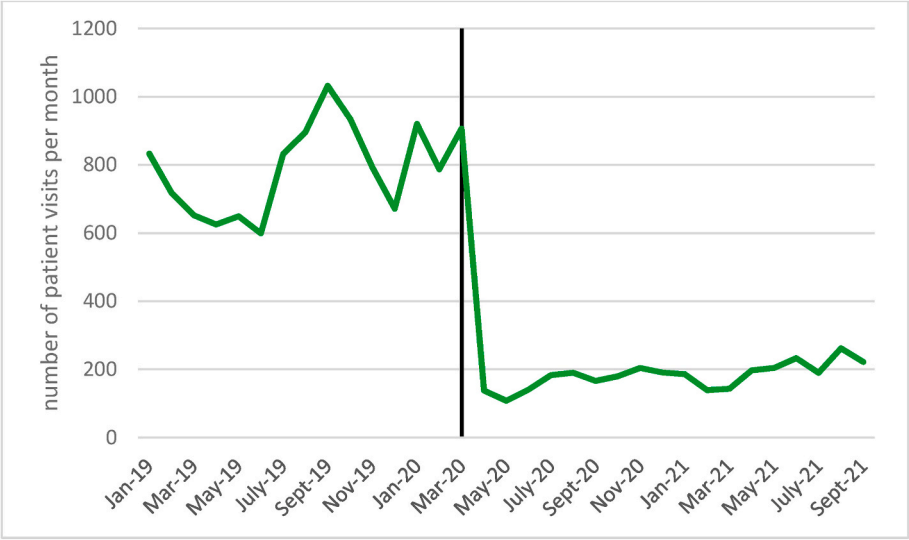

Fig. 1a. Visits per month during the total observation period, N = 15,124.

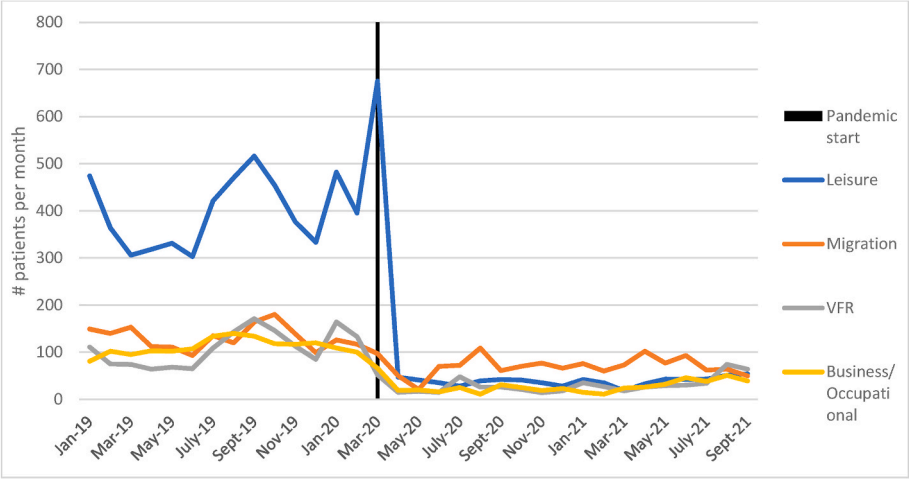

Fig. 1b. Visits per month per travellers' sub-group, N = 14,313. Leisure travellers' visits per month, n = 6916; business/occupational travellers' visits per month, n = 2099; VFR visits per month, n = 2110; Migrant visits per month, n = 3188.

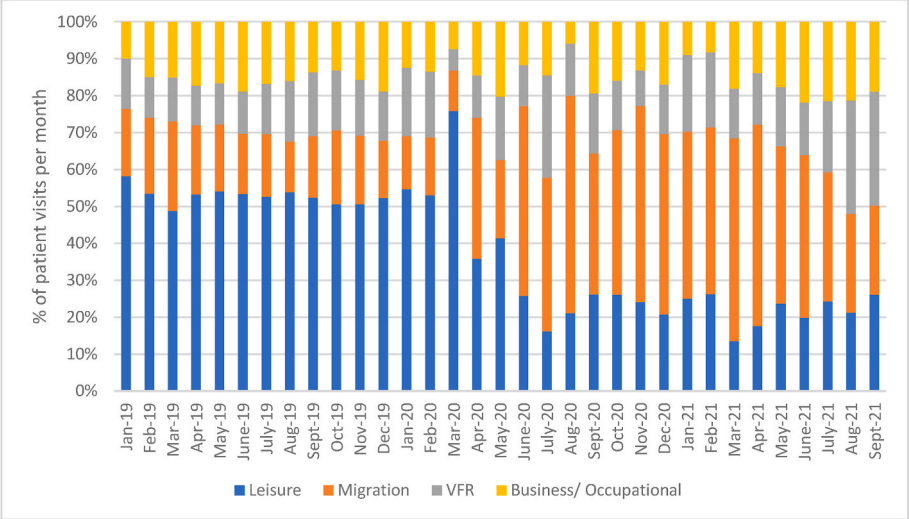

Fig. 1c. Percentage of visits by travellers' category over time, N = 14,313.

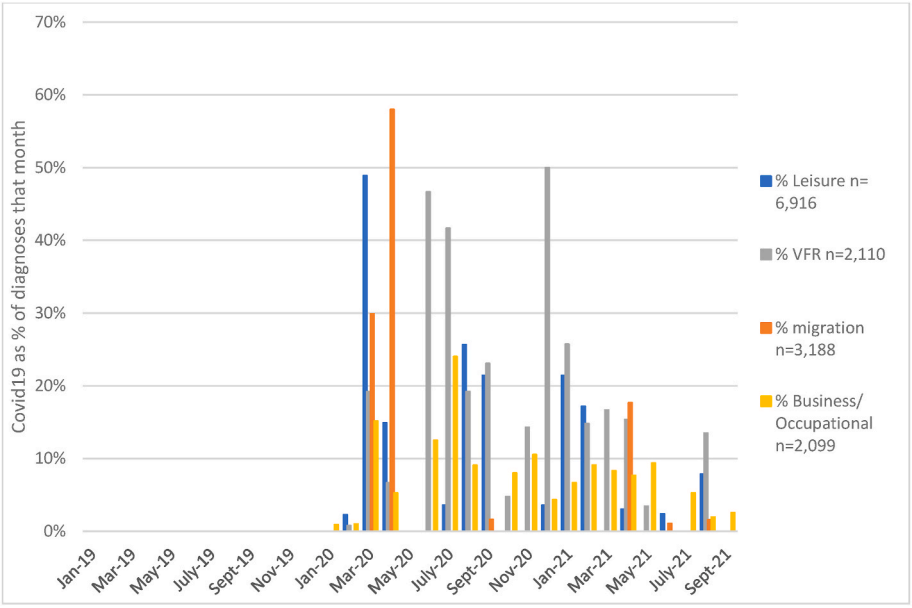

Fig. 2a. Covid-19 diagnoses as a percentage of all diagnoses reported in that month, per traveller category.

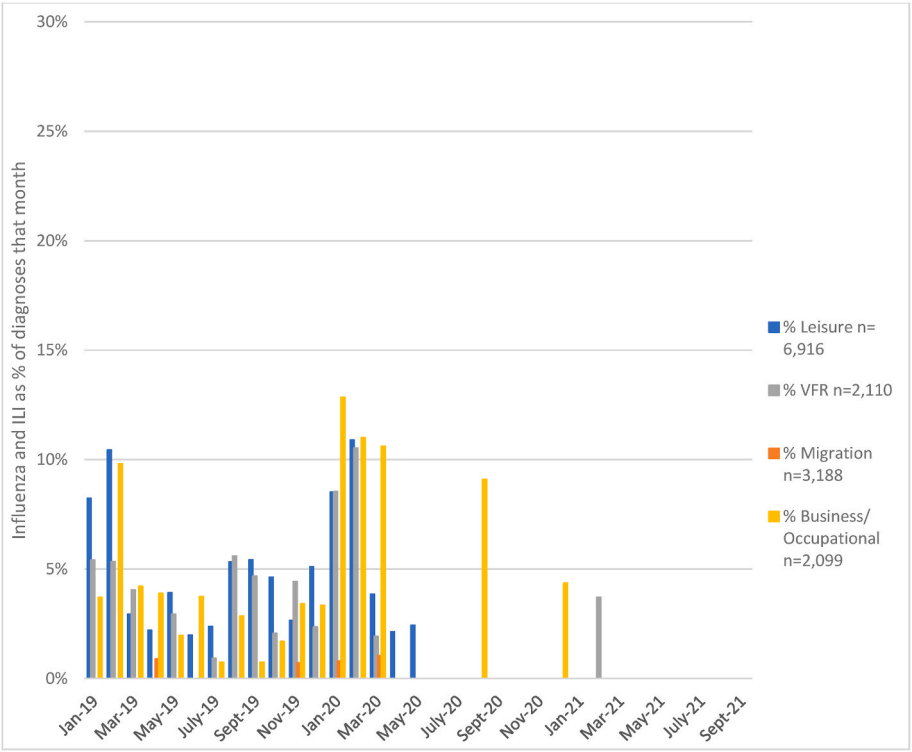

Fig. 2b. Influenza-like illness and confirmed influenza A/B diagnoses as a percentage of all diagnoses reported in that month, per traveller category.

time; Fig. 4 highlights the change in ranking of the top-20 diagnoses during the pre-pandemic period (13,116 diagnoses in 10,941 patients) and the pandemic period (4999 diagnoses in 4183 patients).

With declining numbers and changes in relative frequencies of places visited, the ranking of most-frequent diagnoses changed, both overall (Fig. 4; Table 2) and per travellers' category (Suppl. Fig. 1 a-d; Suppl. Table 2a-d). The three top diagnoses with the largest overall decreases in relative frequency were acute gastroenteritis (−5.3%), rabies post-exposure prophylaxis (rPEP) (−2.8%), and dengue (−2.6%). The three top diagnoses with the largest overall increase in relative frequency, apart from COVID-19 (which rose from 0.1% to 12.7%), were schistosomiasis (+4.9%), strongyloidiasis (+2.7%), and latent tuberculosis (2.4%) (Fig. 4; Table 2). Major diagnoses with little relative change over time were for example giardiasis, not-further-specified viral syndromes, and chronic hepatitis B infection. Where influenza-like illness had been a frequent diagnosis during the pre-pandemic period (in leisure, VFR and occupational travelers), it almost disappeared during the pandemic period (see also Fig. 2a and b).

Table 1a
Top-10 countries of likely exposure over time for non-migrant travelers[1].

Before Mar 2020 (N=8,922)	Average patients per month	Mar-Dec 2020 (N=1,556)	Average patients per month	2021 (N=1,019)	Average patients per month
Thailand	50	Italy	40	Cameroon	6
India	30	Austria	6	DRC	5
Indonesia	24	Thailand	5	Mexico	5
Tanzania	16	India	4	Tanzania	5
Mexico	12	Brazil	3	Ghana	3
Philippines	12	Tanzania	3	Nigeria	3
Brazil	12	Uganda	3	Cote d'Ivoire	3
Cameroon	11	Cameroon	2	Senegal	2
Kenya	11	Spain	2	Guinea	2
Colombia	11	Cote d'Ivoire	2	Kenya	2

[1] Likely exposure countries that were in the top-10 in any time period is highlighted with the same colour coding throughout.

4. Discussion

EuroTravNet sites experienced a drop of 62% in consultations for travel-related infections in the pandemic period observed compared to the pre-pandemic time frame. Different sites experienced the change in numbers of ill travellers at different times and to differing extent; related among other things to the proportion of migrants and VFRs in their patient population, traditional travel destinations for the local population, timing of school holidays and more. Recording of tropical infectious diseases diagnoses declined, with 'typical' diagnoses such as malaria, dengue, chikungunya, and other tropical infections notably decreasing, but continued, indicating that services were not completely disrupted by the COVID-19 pandemic and superimposed task shifting.

Top-10 countries of exposure for non-migrants changed after onset of the COVID-19 pandemic, with destinations such as Italy and Austria, where COVID-19 exposure peaked in the first months, replacing typical travel destinations in Asia (Thailand, Indonesia, India). In due course, towards 2021, travel to a small number of countries increased, especially Mexico and Tanzania, that adopted tourism promoting-policies in spite of high in-country COVID-19 rates. For migrants, although the numbers of reports decreased, the top likely exposure countries were very stable; primarily from Bolivia, Mali and Senegal across the time periods.

Of note, conclusions about how the countries of exposure changed through the pandemic depend on a multitude of factors, including reason for travel; Covid-19 hotspot development; and individual-country entry and travel restriction implementations, or the absence thereof, given the large decrease in overall travel after March 2020.

The overall changes observed in relative and absolute frequencies of diseases reflect the absolute decline in numbers particularly of acute diseases seen in recently returning travellers. We can speculate that a potential reason for proportional increases in chronic conditions such as schistosomiasis even among leisure and occupational travellers being that these might be related to pre-pandemic travel with continuing symptoms. However, we are not able to address this with this data.

The absolute and proportional decrease in cases of influenza like illness, influenza A, upper respiratory infections and unspecified febrile (<3 weeks) could be related to the impact of mitigation measures for Covid-19, as well as the increased need to differentiate Covid-19 infections from the list of differential diagnoses. Often, region-specific infectious diseases conditions featured highly on the list of differential diagnoses (for example; not infrequently, patients primarily having been suspected of having malaria would turn out to be COVID-19-positive instead; but also vice versa; as well as in combination).

Some sites (data not shown) saw a large number of patients at a time in the pandemic period from March 1, 2020 onwards, as part of SARS-CoV-2 testing, and from 'non-tropical' regions, the reason being that many of the centers do provide general infectious diseases services, too, rather than being confined to strictly 'tropical medicine' cases. As one example, millions of people from Eastern European countries are residents, immigrants or seasonal workers in Western Europe and in March–April 2020, hundreds of thousands of them returned home, creating a huge potential for imported cases. This wave of returned people can be observed and explains for example the peak of cases in Bucharest, Romania for March–April 2020 [8,9].

In summary, while there was a precipitous drop in the numbers of patients seen at EuroTravNet site, there was heterogeneity in how sites experienced it in terms of number of patients, types of patients, their diagnoses and the exposure countries in both actual and relative terms.

In general, travellers are at an increased risk of acquiring COVID-19, and contribute to the global spread of the virus. For 2019, the International Air travel Association (IATA) recorded 4.5 billion passengers transported on 39 million scheduled flights (with 117 per flight on average), with 8.7 trillion revenue passenger kilometers (RPKs) flown (1911 km per departure on average) [4,10] and for 2018, according to the United Nations World Travel Organization, UNWTO, an estimated

Table 1b
Top-10 countries of likely exposure over time for migrant travelers[1].

Before Mar 2020 (N=1,850)	Average patients per month	Mar-Dec 2020 (N=695)	Average patients per month	2021 (N=657)	Average patients per month
Bolivia	32	Bolivia	19	Bolivia	13
Guinea	17	Mali	4	Mali	11
Senegal	6	Senegal	3	Senegal	6
Mali	5	France	3	India	4
Equatorial Guinea	5	Colombia	2	Gambia	4
Cote d'Ivoire	4	Guinea	2	Morocco	3
Pakistan	4	Ecuador	2	Guinea	2
Morocco	3	United Kingdom	2	Cameroon	2
Colombia	3	Peru	2	Ecuador	2
Nigeria	3	El Salvador	2	Cote d'Ivoire	2

[1] Likely exposure countries that were in the top-10 in any time period is highlighted with the same colour coding throughout.

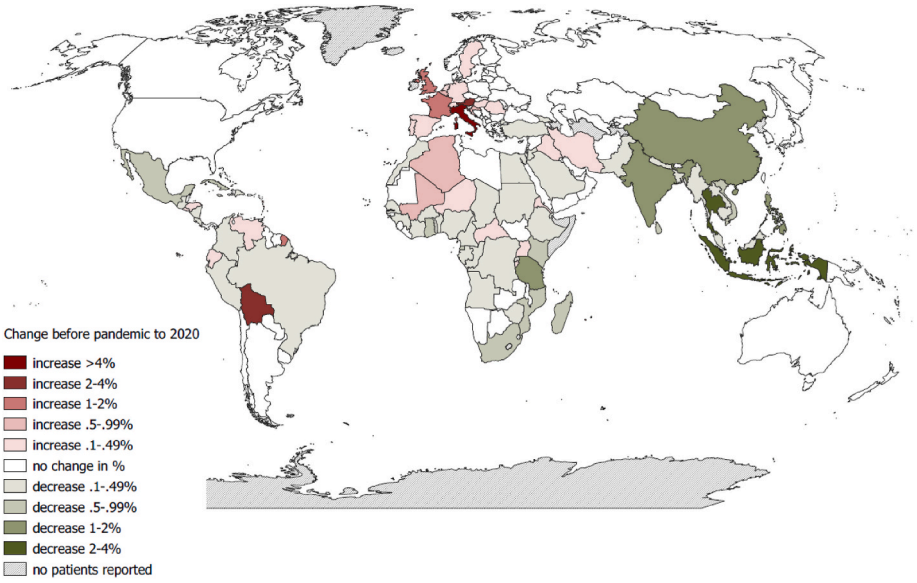

Fig. 3a. Change in proportion of patients exposed from before March 2020 to March–December 2020.

58% of international overnight visitors reached their destination by air [3,4]. These figures dropped dramatically by clearly more than 50% for both passenger departures and RPKs flown [4,10] – but in any case sufficient to be a major driver of the global COVID-19 spread, as well as high-speed long-distance rail travel as demonstrated for China [11]; and as multiple phylodynamic studies from all global regions demonstrate

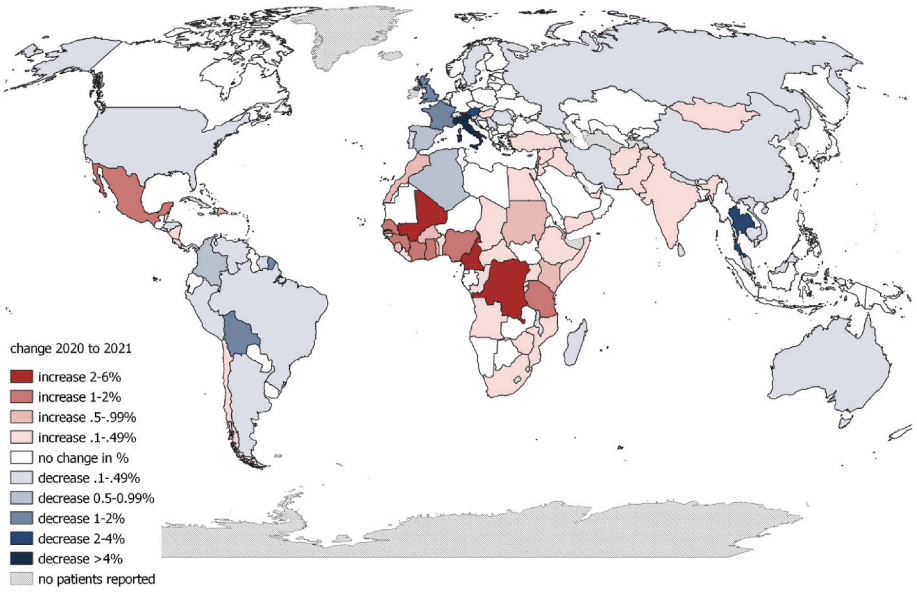

Fig. 3b. Change in proportion of patients exposed from March–December 2020 to January–September 2021.

Table 2
Major diagnoses and relative changes over time for top diagnoses in each of the three categories 'increased frequency', 'stable frequency', 'decreased frequency'[1].

Top diagnoses	N patients Jan 2019-March 2020	%	N patients March 2020-Sept 2021	%	change in %
COVID-19	13	0.1	636	12.7	12.6
SCHISTOSOMIASIS, UNSPECIFIED	431	3.3	411	8.2	4.9
STRONGYLOIDIASIS	491	3.7	323	6.5	2.7
LATENT TUBERCULOSIS	150	1.1	176	3.5	2.4
CHAGAS DISEASE, CHRONIC	461	3.5	288	5.8	2.2
BLASTOCYSTIS INFESTATION	79	0.6	82	1.6	1.0
FALCIPARUM MALARIA	662	5.0	291	5.8	0.8
SCHISTOSOMIASIS MANSONI	85	0.6	56	1.1	0.5
HEPATITIS B, CHRONIC (>6 MONTHS) OR UNSPECIFIED DURATION	132	1.0	65	1.3	0.3
VIRAL SYNDROME (WITH/WITHOUT RASH)	614	4.7	224	4.5	-0.2
SSTI[2]	224	1.7	59	1.2	-0.5
GIARDIASIS	318	2.4	94	1.9	-0.5
EOSINOPHILIA	241	1.8	62	1.2	-0.6
DIARRHOEA, CHRONIC UNSPECIFIED	397	3.0	120	2.4	-0.6
CUTANEOUS LARVA MIGRANS, HOOKWORM-RELATED	220	1.7	45	0.9	-0.8
INSECT OR OTHER ARTHROPOD BITE/STING	289	2.2	70	1.4	-0.8
INFLUENZA A	148	1.1	14	0.28	-0.8
BITE, DOG	182	1.4	21	0.42	-1.0
FEBRILE ILLNESS, UNSPECIFIED (< 3 WEEKS)	263	2.0	38	0.76	-1.2
UPPER RESPIRATORY TRACT INFECTION	238	1.8	25	0.5	-1.3
INFLUENZA - LIKE ILLNESS	277	2.1	14	0.28	-1.8
DENGUE, UNCOMPLICATED	599	4.6	96	1.9	-2.6
RABIES PEP (post exposure prophylaxis)	519	4.0	59	1.2	-2.8
ACUTE GASTROENTERITIS	1002	7.6	149	2.3	-5.3

[12–16], with Europe having been the epicenter, and consequently the main source for the global spread of COVID-19 at least in the first phase of the pandemic [17].

Consequently, particularly in the early phase of the pandemic, border closures were part of the efforts to contain, or at least slow down, the spread of SARS-CoV-2. Wells and colleagues [18] calculated that China border closures and travel lockdowns averted around 70% of additional exported cases during the first weeks of the outbreak, thus buying some time to mount public health responses; but for the phase after the initial spread of the virus, other researchers found no evidence

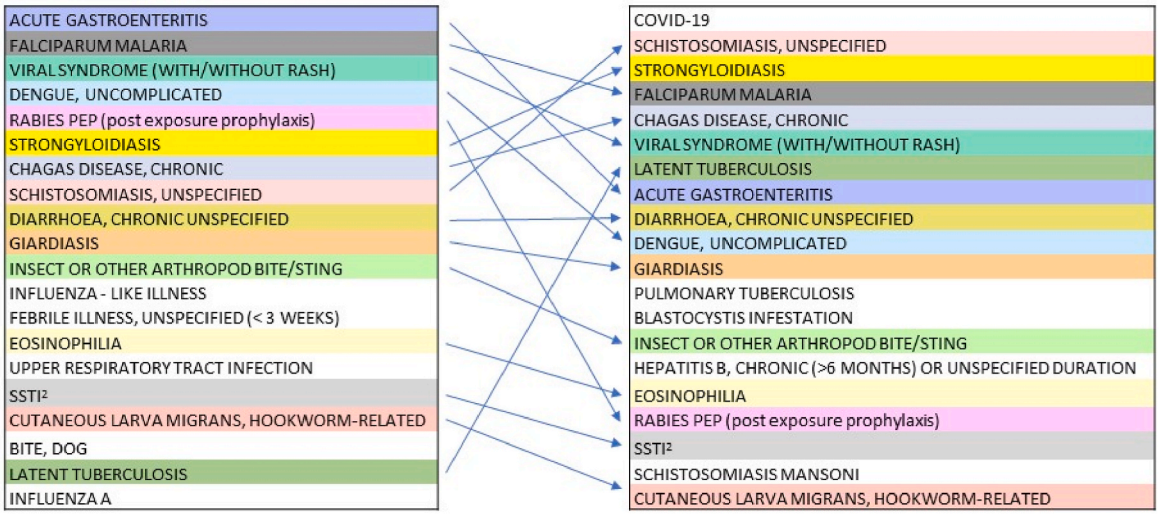

Fig. 4. Total 20 top diagnoses before March 2020 (N = 13,116 diagnoses in 10,941) patients) and from March 2020 (n = 4999 diagnoses in 4183 patients).

in favour of international border closures [19], weak evidence for air travel restrictions [20] and an early Cochrane Database systematic review found in essence only very low-certainty evidence for COVID-19 community cases and cases exported or imported [21]; with the same applying to screening at borders. Zhang and Jin [22] concluded that, with regard to COVID-19 and beyond, travel restrictions alone do not have a significant, sustainable effect other than buying time, if combined with other measures, until effective treatments and vaccines to effectively curb the spread become available.

There are several limitations to our manuscript; the most important one being that the data, as we focused on Europe because the pandemic enfolded itself here similarly over time, cannot be generalised beyond travel medicine sites in Europe. Furthermore, with the pandemic unfolding, shifting of staff, re-purposing of resources, temporary work overload and, in part, cessation, of normal operations might have added an element of reporting bias. However, sites continued to see the patients who reported for suspicion of travel-related illness even while the actual number of patients dropped significantly.

EuroTravNet data collection hinges on convenience sampling. Data are not population-based, and there is no denominator data on non-ill travellers. Therefore, incidence and risk cannot be calculated, and thus to tell why the proportion of some diagnoses dropped so significantly remains speculative to some extent. Also, in some sites, workforce had to be diverted largely towards gaining control over the COVID-19 surge of patients; which might have resulted in non-uniform reording and thus representation of certain diseases. However, the changes in likely country of exposure in non-migrant travellers mirrors the actual tourist arrivals reported by UNWTO; supporting the idea that changes were at least partly a result of the change in travel patterns.

Overall, the dynamics of COVID-19 and travels demonstrated once again that infections are no more limited by country boundaries, but they should be considered in a global health view.

Similar kinetics with drastic reductions in patient numbers, and service disruptions have been observed in all sectors of societies as a consequence of the pandemic, and are obviously not only confined to healthcare [23,24]. Towards the end of the COVID-19 pandemic, the path to sustainable recovery remains unclear.

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CRediT authorship contribution statement

Martin P. Grobusch: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Leisa Weld:** Methodology, Formal analysis, Writing – review & editing. **Jenny L. Schnyder:** Investigation, Writing – review & editing. **Carsten Schade Larsen:** Investigation, Writing – review & editing. **Andreas K. Lindner:** Investigation, Writing – review & editing. **Corneliu Petru Popescu:** Investigation, Writing – review & editing. **Ralph Huits:** Investigation, Writing – review & editing. **A. Goorhuis:** Investigation, Writing – review & editing. **Philippe Gautret:** Investigation, Writing – review & editing. **Patricia Schlagenhauf:** Investigation, Writing – review & editing.

Declaration of competing interest

None of the authors has any conflict of interest to declare.

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MPG conceived the paper. LW analysed the data, and MPG and LW wrote the first draft. All EuroTravNet centers contributed data, and all authors contributed to the writing of the final version of the manuscript. We thank Kristina M. Angelo and David Hamer for assisting with data extraction from The GeoSentinel database.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tmaid.2023.102583.

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