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Background: During the COVID-19 pandemic, the majority of patients received ambulatory treatment, highlighting the importance of primary health care (PHC). However, there is limited knowledge regarding PHC workload in Europe during this period. The utilization of COVID-19 PHC indicators could facilitate the efficient monitoring and coordination of the pandemic response. The objective of this study is to describe PHC indicators for disease surveillance and monitoring of COVID-19's impact in Europe. **Methods:** Descriptive, cross-sectional study employing data obtained through a semi-structured *ad hoc* questionnaire, which was collectively agreed upon by all participants. The study encompasses PHC settings in 31 European countries from March 2020 to August 2021. Key-informants from each country answered the questionnaire. Main outcome: the identification of any indicator used to describe PHC COVID-19 activity. **Results:** Out of the 31 countries surveyed, data on PHC information were obtained from 14. The principal indicators were: total number of cases within PHC (Belarus, Cyprus, Italy, Romania and Spain), number of follow-up cases (Croatia, Cyprus, Finland, Spain and Turkey), GP's COVID-19 tests referrals (Poland), proportion of COVID-19 cases among respiratory illnesses consultations (Norway and France), sick leaves issued by GPs (Romania and Spain) and examination and complementary tests (Cyprus). All COVID-19 cases were attended in PHC in Belarus and Italy. **Conclusions:** The COVID-19 pandemic exposes a crucial deficiency in preparedness for infectious diseases in European health systems highlighting the inconsistent recording of indicators within PHC organizations. PHC standardized indicators and public data accessibility are urgently needed, conforming the foundation for an effective European-level health services response framework against future pandemics.

Introduction

During the initial 18 months of the pandemic, Europe documented a total of 69 279 273 confirmed COVID-19 cases as of 30 August 2021.[1] In March 2020, the European Centre for Disease Prevention and Control (ECDC) recommended the rapid detection of cases and monitoring the spread of SARS-CoV-2 infection.[2] To effectively combat to the pandemic, the ECDC developed a contingency plan encompassing primary health care (PHC), hospital settings and long-term facilities.[3] PHC, characterized by first-contact, accessible, continuous, comprehensive and coordinated person-centred care, played a pivotal role.[4] It served as the primary point of contact and was responsible for the initial examinations, follow-up, and complementary testing for COVID-19 patients in numerous European countries.[5,6] The ECDC's also involved establishing dedicated hotlines to separate COVID-19 consultations from other healthcare services, recognizing PHC's critical role in alleviating the burden on hospitals and providing medical care for patients with other conditions. PHC bore a substantial share of the COVID-19 workload,[4] with <10% of all COVID-19 cases requiring hospitalization in Europe[7] and 14% in America.[8] These figures improved with the availability of vaccines.[9]

Despite the immense strain on the entire healthcare system, the World Health Organization (WHO) concentrated solely on monitoring the pandemic by collecting daily data on case and death numbers.[1] Furthermore, the ECDC incorporated indicators like the count of hospitalized cases and admissions to intensive care units (ICUs).[10] In collaboration with the European Commission and other institutions, the European Observatory of Health Systems and Policies developed the COVID-19 Health System Response Monitor to track Europe's response to the pandemic.[11] Within this initiative, the Observatory qualitatively described PHC's role in 38 of the 51 member countries. However, as of now, there are no available reports from European health institutions on the activity of COVID-19 in PHC, specifically regarding the total number of COVID-19 patients attended to in the community. These data are crucial not only for resource allocation to address COVID-19 patients in PHC but also because of its influence on the diagnosis and management of other conditions, including chronic diseases and early cancer detection.[12–14]

Within the European Union, there are two primary sources of information concerning the COVID-19 pandemic. Firstly, the European Surveillance System (TESSy) reports the total number of COVID-19 cases and the percentage of hospitalized patients.[15] It also provides data on the percentage of cases classified as severe and those requiring ventilatory support in ICUs.[16] More recently, EpiPulse was launched to integrate several previously independent surveillance systems,[17] including the TESSy, the five Epidemic

Intelligence Information System platforms, and the Threat Tracking Tool. This platform offers new functionalities and seamless data access through a single platform. However, it currently does not include COVID-19 data from PHC at the European level. To prepare for future waves of COVID-19 or emerging pandemics, it is imperative to understand what information has been gathered and published regarding the care of COVID-19 patients in PHC. Therefore, this study aims to describe the existing national indicators and potential indicators for disease surveillance and monitoring the disease burden of COVID-19 in PHC in Europe. Additionally, the study seeks to evaluate the availability of fundamental indicators as open data in each country.

Methods

Study design and setting

This retrospective descriptive study used a semi-structured questionnaire to collect data from 31 European countries spanning from the 12th epidemiological week (15 March 2020) to the 43th epidemiological week (31 August 2021). This research is an integral part of the Eurodata study, whose primary objective is to investigate the role of PHC during the COVID-19 pandemic in Europe.[5,18]

Participants

This study involved the following countries: Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Cyprus, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, North Macedonia, Norway, Poland, Romania, Serbia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and UK. All participants were required to have actively engaged in or been associated with COVID-19 response efforts in their respective countries during the pandemic. They were health professionals proficient in English and served as lead researchers in their respective countries. The majority of participants worked in general practice, except for those from Lithuania, who were involved in Public Health during the study period. Recruitment of key-informants was carried out through an open invitation within the European General Practice Research Network working group and the World Organization of Family Doctors in Europe.

Data collection

Variables to be collected:

- **Main outcome:** The primary objective was to identify national or regional indicators describing disease surveillance and disease burden within PHC during the pandemic in the participating countries. COVID-19 disease surveillance indicators included: COVID-19 testing and the total number of COVID-19 cases reported in PHC. Disease burden indicators in PHC included: COVID-19 advice provided, surveillance of COVID-19 patients isolating at home, consultations with a general practitioner (GP) or other PHC professionals for COVID-19 related concerns, the total number of chest X-rays and blood test performed on COVID-19 patients, the total number of COVID-19 patients requiring follow-up through in-person or remote assessments in PHC, as well as other relevant indicators.
- **Secondary outcomes:** Secondary outcomes encompassed various aspects, including the first point of contact within the health system (PHC, hospital, Accident & Emergency department, Public Health), the total number of people infected by SARS-CoV-2, hospitalizations, ICU admissions, deaths and the proportion of COVID-1 cases within PHC from as a percentage of the national total. Additionally, the study also assessed aspects, such as COVID-19 as a notifiable disease, the presence of a COVID-19 hotline, coding system within PHC and demographic information, such as gender and age distribution among individuals infected by SARS-CoV-2. Definitions of these terms can be found in Supplementary file S1.

Data collection instruments

To collect all the necessary data, a comprehensive questionnaire was developed (Supplementary file S2). The questionnaire was constructed based on the open data provided by the ECDC[19] and WHO,[1] supplemented by open-ended questions aimed at capturing regarding PHC-specific indicators.

Data were gathered from official sources (Supplementary file S3) and a peer-review of the national data and the international findings was conducted. At least two key-informants from each country were responsible for validation of the national data before submission to the core research team. The research team subsequently conducted a peer-review of all the submitted data, assessing potential bias and inconsistencies. In case of unclear data, key-informants were contacted to provided further details to complete the initial dataset. Any disagreements or discrepancies were thoroughly discussed and resolved among within the core research team and with the input of key-informants.[5]

Results

In this study, it was observed that COVID-19 was categorized as a notifiable disease in all countries included in this study. Every participant confirmed that their respective nations openly reported the cumulative count of COVID-19 cases and fatalities, which can be found in table 1 and graphically represented in figure 1. Furthermore, data stratified by gender and age range were accessible in 26 countries, and Norway went a step further by offering data on the number of migrants affected by COVID-19. Hospitalization information was accessible for 25 countries, while data on ICU admissions were also available for 25 countries. Notably, a few countries updated this information on a daily basis.

The use of international diseases classification systems by PHC providers was consistent across all countries, except for Austria, where it was primarily voluntary and limited to the internal use within the unit, and Switzerland, where systematic coding was not obligatory (table 1). Among the classification systems employed, ICD-10 was the most widely used, followed by ICD-9 and ICPC-2. Thirteen out of 31 countries gathered primary disease surveillance data that were publicly accessible. However, the majority of countries did not publicly collect information on PHC operations and workload during the pandemic (as shown in figure 2).

Overall, participants identified a total of 40 COVID-19 indicators related to the burden on PHC. The most frequently reported indicator was the total number of cases recorded in PHC, as reported by Belarus, Cyprus, Italy, Romania and Spain. This was followed by the number of patients whose follow-up was coordinated by a PHC provider, as reported by Croatia, Cyprus, Finland, Spain and Turkey. All the PHC indicators can be found in table 2.

The burden of suspected cases in PHC was described using suggested indicators in Belgium, Cyprus, Finland, France, Switzerland and UK. UK proposed measuring the workload of COVID-19 cases in PHC by calculating the number of suspected cases per 100 000 of all GP consultations. Norway recommended reporting the percentage of COVID-19 cases (including suspected and confirmed cases) among all PHC consultations. Croatia proposed 11 indicators to describe the type of contact between PHC personnel and COVID-19 patients. Finland suggested using the number of face-to-face appointments with GPs as an indicator of the COVID-19 burden on PHC. Additionally, Croatia reported the number of patient examinations, and Cyprus reported the number of supplementary tests conducted in PHC. Information from sick leaves issued by GPs was recorded in Romania and Spain. The PHC variables derived from the Sentinelle Surveillance system in Switzerland consisted of a network of 160–180 GPs who voluntary reported the number of

Table 1 Description of the first-contact with the health system, the coding system in PHC and general COVID-19 indicators in 31 European countries. The data spans from 1 March 2020 (12th epidemiological week) to 31 August 2021 (43th epidemiological week)

Country	Patient's first contact with health system	Coding classification in PHC	Total cases	Information regarding sex in total cases	Information regarding age range in total cases	Total hospitalized cases	Number of ICU patients	Total deaths
Austria	GP/Hotline	No coding[a]	684 962	Yes	Yes	Daily	Daily	10 772
Belarus	GP	ICD-10	48 505	Not available	Not available	Not available	Not available	3780
Belgium	GP/A&E	ICD-10/ICPC-2/ Thesaurus 3BT	1 178 646	Yes	Yes	77 177	13 055	25 525
Bosnia and Herzegovina	GP/Hotline	ICD-10	156 031	Yes	Yes	Daily	Daily	8195
Bulgaria	GP/A&E	ICD-10	453 689	Not available	Yes	3594	301	18 840
Croatia	GP/paediatrician/ PH/A&E/Hotline	ICD-10	373 348	Yes	Yes	31 645	Not available	8329
Czech Republic	PHC	ICD-10	1 666 125	Yes	Yes	Daily	Daily	30 506
Cyprus	GP	ICD-10	215 208	Yes	Yes	8452	954	871
Finland	PHC/private sector/App	ICD-10/ICPC-2	131 059	Yes	Yes	4629	935	1062
France	GP/Hotline	CISP	6 765 708	Yes	Yes	460 000	94 000	116 000
Germany	GP/Hotline	ICD-10	3 842 856	Yes	Yes	282 785	Daily[c]	92 200
Greece	PHC/Hotline	ICD-10	587 964	Yes	Yes	87 781	8532	13 691
Hungary	PHC	ICD-10	812 305	No	No	No	No	30 058
Ireland	PHC, hospital	ICD-10	353 789	Yes	Yes	16 075	1776	4897
Israel	COVID-19 telephone Hotline	ICD-9	1 077 780	Yes	Yes	Daily	20 227[b]	7135
Italy	GP/out of hours	ICD-9	4 581 713	Yes	Yes	50 399	3377	129 070
Latvia	GP/A&E	ICD-10	142 611	Yes	Yes	Not available[d]	Not available[e]	3471
Lithuania	PHC/telephone Hotline/112	ICD-10	142 244	Yes	Yes	Weekly	Weekly	9250
Luxembourg	GP/Hotline/hospital	ICD-10	75 760	Yes	Yes	4865	673	830
North Macedonia	PHC	ICD-10	177 399	Yes	Yes	Daily	Daily	5964
Norway	PHC	ICPC	158 132	Yes	Yes	4710	899	880
Poland	PHC	ICD-10	2 865 673	No	No	Not available	Not available	75 269
Romania	PHC/Hotline	ICD-10	1 097 268	Yes	Yes	2303	280	34 514
Serbia	GP	ICD-10	762 885	Not available	Not available	495 831	26 390	7292
Slovenia	PHC/Hotline/PH	ICD-10	268 055	Yes	Not available	18 517	2954	4450
Spain	GP/A&E	ICPC-2	4 888 230	Yes	Yes	403 128	40 272	86 642
Sweden	PHC/Hotline	ICD-10	1 126 531	Yes	Yes	21 162	7712	14 694
Switzerland	GP/Hotline/A&E	No coding[h]	774 516	No	Yes	Daily	Daily	10 491
Turkey	PHC, Hotline	ICD-10	6 273 356	Yes[f]	Yes[f]	Not available	Daily[g]	56 710
Ukraine	GP	ICPC-2	2 286 293	Yes	Yes	Not available	Not available	53 788
UK	Phone line or online platform	ICD-10	6 076 262	Yes	Yes	Daily	Daily	117 455

Notes: A&E, Accident and Emergency Department; GP, general physician; PHC, primary health care, which includes GP, PHC nurses and other ambulatory healthcare professionals; PH, public health; ICU, intensive care unit.

a: Less than 1% of PHC centres (ICPC-2) and outpatient departments of Social Health Insurances (ICD-10) in Austria use a coding classification system.

b: This result includes severe cases (defined as those with a respiratory rate >30 breaths per minute, oxygen saturation at or below 93% and a PaO2/FiO2 < 300) whether they are candidates for ICU admissions or not.

c: Data regarding ICU admission in Germany were recorded and available daily until July 2021, after which cases were counted as total ICU cases.

d: Data on hospitalized patients are accessible from 1 January 2021.

e: These data include both moderate and severe diseases and it is not limited to ICU cases.

f: Sex and range age information is available from March 2020 to October 2020.

g: The information is from severe cases that could potentially require ICU admission, with data available up to 3 July 2021.

h: In Switzerland, systematic coding is not mandatory in ambulatory care, and electronic health record coverage is not 100%.

initial contacts (including practice and house visits) with patients suspected of having COVID-19. The Sentinelle GP network in France collected information on the positivity rates of SARS-CoV-2 among all respiratory infections, as well as the estimated incidence of COVID-19 cases per 100 000 populations with respiratory symptoms observed.

Discussion

In this cross-sectional study involving 31 participating countries, it was found that 14 of them made their COVID-19-related PHC data accessible to the public. The indicators used to describe this burden varied considerably across countries. The most frequently recorded indicators were the total number of COVID-19 cases in PHC, followed by the number of follow-up cases in PHC. Additional indicators included the number of COVID-19 tests administered, the number of sick leaves issued by GPs and the count of consultations or complementary tests in PHC. Surprisingly, the percentage of COVID-19 cases among all GP consultations was rarely documented. Furthermore, some countries did not provide information regarding hospitalization and ICU admissions. On a more positive note, the majority of countries shared disaggregated data by age and gender, providing a more comprehensive insight into the impact of COVID-19 on diverse demographic groups.

Historically, public health surveillance primarily concentrated on enumeration of cases and fatalities. As the field evolved, it incorporated supplementary information, such as data on health service delivery, to enhance the quality response plans.[20] This study aimed to analyze national data to delineate key COVID-19 indicators in PHC, encompassing total cases, demographic breakdowns, hospitalizations, ICU admissions and total fatalities. However, only 2 out of the countries included in the study collected all these indicators at the national level. While most countries adhered to common indicators for essential data, crucial agencies, such as the ECDC and the

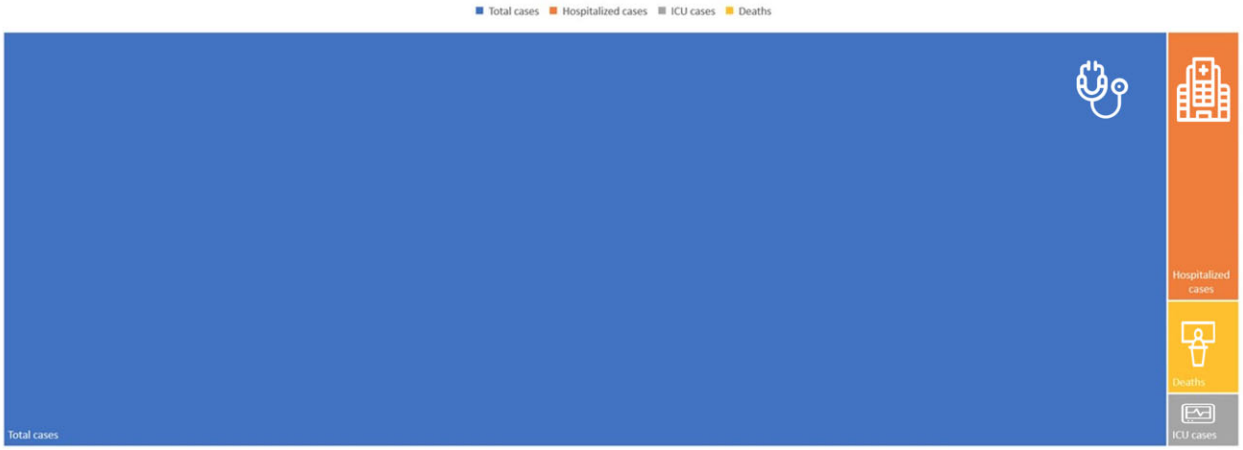

Figure 1 A TreeMap illustrates COVID-19 cases and the proportion of hospitalized cases, ICU cases and fatalities among the total cases. The data represented are sourced from those countries that shared quantitative information in table 1.

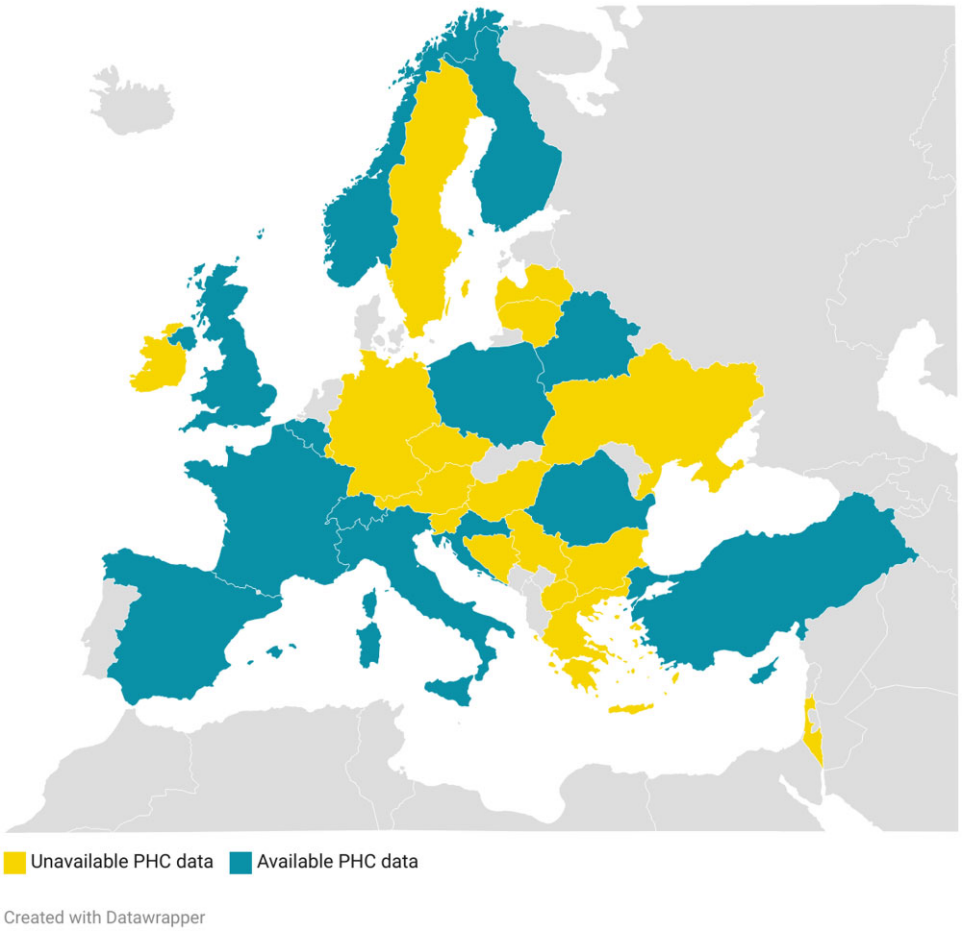

Figure 2 Depicts participating countries with and without available COVID-19 data in PHC

WHO, did not publicly release a standardized minimum COVID-19 surveillance datasets to be reported as open data.[21,22] For instance, the ECDC does not require the collection of sex as a mandatory dataset. Additionally, the accessibility of cumulative data as an open data resource proved to be challenging during the study period. Transparent data sharing is indispensable for an integrated pandemic response and research, as fragmented data hinder policy comparison and the identification of disease and mortality patterns.[23] Several reasons have been given to explain the limited data available, including insufficient investment in local public health surveillance,[24] a lack of interoperable public health data[25] and time-oriented metrics for sharing information with the public.[26] Remedial efforts are warranted to address these issues and enhance data quality in Europe. Notably, the European Commission has proposed a Regulation on a European Health Data Space to address some of these concerns.[27]

The acquisition of PHC data for COVID-19 in 14 countries represents a significant advancement, enabling a better understanding

Table 2 COVID-19 indicators in PHC per country from 15 March 2020 (12th epidemiological week) until 31 August 2021 (35th epidemiological week)

Country	PHC indicators	Result of the indicator	Total cases in PHC/total national cases (%)
Belgium	Total number of any contacts with GP with ICPC-2 R80 (suspected COVID-19) recorded as reason for the contact.	435 858	Not available
	Total number of any contacts with GP with ICPC-2 A77 (confirmed COVID-19) recorded as reason for the contact.	111 526	Not available
Belarus[a]	Total COVID-19 cases in PHC	48 505	100%
Croatia	Total number of procedures to patients in PHC with ICD-10 U07.1 (confirmed COVID-19) recorded as reason for procedures	681 415	Not available
	Total number of phone consultations to patients with ICD-10 U07.1 or patients close family member (by physician)	480 484	Not available
	Total number of consultations with ICD-10 U07.1 recorded as reason for consultation (by physician)	27 853	Not available
	Total number of first visits (examinations) with ICD-10 U07.1 recorded as reason for the visit (by physician)	46 777	Not available
	Total number of control visits (examinations) with ICD-10 U07.1 recorded as reason for the visit (by physician)	90 698	Not available
	Total number of first home visits with ICD-10 U07.1 recorded as reason for home visit (by physician)	1797	Not available
	Total number of control home visits with ICD-10 U07.1 recorded as reason for home visit (by physician)	1474	Not available
	Total number of home care with ICD-10 U07.1 recorded as reason for home care (by physician)	305	Not available
	Total number of telephone consultations with ICD-10 U07.1 recorded as reason for consultation (by nurse)	31 939	Not available
	Total number of the first home visits with ICD-10 U07.1 recorded as reason for home visit (by nurse)	62	Not available
	Total number of control home visit with ICD-10 U07.1 recorded as reason for home visit (by nurse)	26	Not available
Cyprus	Total COVID-19 cases in PHC	61 093	28.38%
	Total number of suspicious patients who were checked in PHC (symptoms and COVID-19 testing)	81 881	Not available
	Total number of patients who were follow-up in PHC	58 469	Not available
	Total number of patients who were examined in PHC (X-ray or/ and phlebotomy)	26 855	Not available
Finland	Total number of contacts to PHC with ICPC-2 R83 recorded as reason for the contact.	1 263 626	Not available
	Total number of any contacts with GP with ICD-10 U07.1 recorded as reason for the contact.	100 274	Not available
	Total number of face-to-face visits to GP with ICD-10 U07.1 recorded as reason for the visit.	7927	Not available
	Total of COVID-19 patients in primary care hospital units per day (reported separately from specialized care hospitalization from 7 December 2020, range: 1–147)	Mean 42, SD 28, median 33	
France	Total of number of home care visits of COVID-19 suspicious cases by GP[b]	72 395	Not available
	Description of confirmed cases of COVID-19 seen in general practice[c]	Weekly basis	Not available
	Positivity rates to SARS-CoV-2 (Covid-19) among all the respiratory infections by the Sentinelles network[c]	Weekly basis	Not available
	Estimated incidence of COVID-19 cases per 100 000 population with respiratory signs observed in general practice through the Sentinelles network[c]	Weekly basis	Not available
Italy[a]	Total COVID-19 cases in PHC	4 531 314	98.89%
	Sex of total cases in PHC (males/female)	2 248 428/2 333 266	Not available
	Sex of total deaths in PHC (males/female)	72 900/56 170	Not available
Norway	Percentage of cases of COVID-19 among all respiratory infection cases in PHC	Weekly basis	Not available
	Percentage of PHC consultations with the diagnosis codes COVID-19 (confirmed), COVID-19 (suspicious) and microbiological/immunological test for all age groups	Weekly basis	Not available
Poland	Total number of COVID-19 test referrals issued by GPs	4 163 966	Not available
	Percentage of test referrals issued by GPs/total number of all tests performed	70.5%	Not available
Romania	Total cases in PHC	1 087 100	99.07%
	Total number of sick leaves processed by GPs of patients in quarantine	53 200	Not available
	Total number of sick leaves processed by GPs of COVID-19 patients in isolation	45 432	Not available
Spain	Total number of sick leaves processed by GPs of patients in quarantine[d]	2 536 717	Not available
	Total number of sick leaves processed by GPs of COVID-19 patients in isolation[d]	1 233 081	Not available
	Total cases in PHC (Castilla-León region)	359 555	Not available
	Cumulative incidence in PHC (Castilla-León region)	38 027	Not available
	COVID-19 rate per 100 000 inhabitants in PHC (Castilla-León region)	15 847.9	Not available
	Total number of active cases at PHC (Castilla-León region)	Daily basis	Not available
	Percentage of daily increase in COVID-19 cases in PHC (Castilla-León region)	Daily basis	Not available

(continued)

Table 2 Continued

Country	PHC indicators	Result of the indicator	Total cases in PHC/total national cases (%)
	Incidence by age groups and sex in PHC (Castilla-León region)	Available	Not available
	COVID-19 rate per 100 000 inhabitants by age groups in PHC (Castilla-León region)	Available	Not available
	Total number of daily follow-up of COVID-19 cases in PHC (Madrid region, from 22 April 2020)	950 277	Not available
	Total number of daily follow-up of COVID-19 cases in PHC (Navarra region, from 27 March 2020)	185 302	Not available
	Total number of active cases at home in PHC (Canary Islands region and Murcia region)	Daily basis	Not available
Switzerland	Number of suspected COVID-19 contacts	21 962[f]	Not available
UK	Seven-day GP consultation rate per 100 000 population of suspected Coronavirus cases (Wales)	Daily basis	Not available
	Number and rate of suspected Coronavirus per 100 000 of GP consultations per week (Wales)	Weekly basis	Not available
Turkey[e]	Total number of family medicine follow-up ratio: follow-up ratio of cases and contacts whose quarantine process and home follow-up continues	89.53%	Not available

Notes: PHC, primary health care; ICD-10 U07.1 and ICPC-2 R83, codes that correspond to COVID-19 disease for the Finnish Institute for health and Welfare.
a: All COVID-19 cases are firstly attended in PHC to receive any medical care.
b: This information corresponds to GPs who are part of the 'SOS médecins' network.
c: The Sentinelles network comprises sentinel GPs and paediatricians that report the number of cases of acute respiratory infection (ARI) seen in consultation (or teleconsultation), according to the following definition: sudden onset of fever (or feeling of fever), and respiratory signs. For each reported case of ARI, descriptive data are collected, including the results of antigenic or PCR tests for COVID-19.
d: Data are available till 11 March 2021.
e: Data corresponding to October 2020.
f: PHC variables result from the Sentinala Surveillance system consisting of a GP network of 160–180 participants who transferred on a voluntary basis their number of first contacts.

of healthcare delivery during the pandemic in Europe.[28] The use of coding systems in PHC played a crucial role in obtaining this information, with Austria and Switzerland being the only exception to their widespread application. Measuring the impact of the COVID-19 pandemic on PHC workloads is undeniably crucial. Such data can contribute to the prediction of trends in hospitalization and ICU admissions, providing an average lead time of 2 days.[29] This would provide more time for efficient proactive planning to ensure the availability of sufficient beds in secondary care or other healthcare facilities. Beyond that, the implications for long-term care facilities, as highlighted in this project, should not be disregarded and defining the workload is beneficial for all the professionals involved.[18] It is essential to establish standardized indicators to predict the impact on regular healthcare services. Furthermore, the provision of regular care is compromised when PHC practitioners are attending to and following up on COVID-19 patients as the availability of appointments may be reduced due to high demand[29] and the quality of care for chronic conditions and cancer screening can suffer negative consequences.[12,14] A study involving moderate and severe COVID-19 cases revealed that these patients required an average of 12 follow-up phone calls from PHC professionals during the 6 months following their infection.[31] The long-term workload implications in PHC for cases of long COVID remain unknown. Specific indicators for PHC would be instrumental to understand the healthcare system workloads, motivating the allocation of resources and garnering the attention of policy makers.

The heterogeneity of PHC indicators in our study highlights the challenge of quantifying the events that occurred in PHC during the pandemic. Various methods have been proposed to measure the pandemic's impact on PHC. While the WHO has introduced 20 indicators to monitor healthcare capacity and utilization, specifically designed to aid decision-making during the pandemic,[32] there is currently a lack of indicators focused on monitoring COVID-19 activity in PHC. The only significant indicator available is the total number of COVID-19 outpatient consultations on a monthly basis, which contributes to understanding the pandemic's impact on essential health services. It is noteworthy that the indicators provided by the Center for Disease Control and Prevention for monitoring COVID-19 community levels and making public health recommendations primarily rely on hospital-related indicators, neglecting to incorporate PHC activity indicators.[33] In Australia, an initiative to develop new information systems, including primary care data, has been launched but has yet to provide public data.[34]

Upon analyzing the collated European PHC COVID-19 indicators, we observed various viewpoints: the total number of patients, the total number of contacts with PHC and the total number of procedures (tests, blood tests, chest X-rays and sick leaves). Each dataset provides a different perspective that aids in better understanding the high workload experienced by PHC during the pandemic. In our opinion, future disease surveillance efforts would greatly benefit from the establishment of a dashboard incorporating new indicators to monitor not only the pandemic but also the COVID-19 workload in PHC. A promising step would be the tracking of the total number of COVID-19 cases in PHC.

In this study, we observed that some countries documented the number of contacts with suspected cases. These cases are significant as they prompt individuals to seek contact with a PHC professional, as they can be mistaken for other respiratory illnesses. Consequently, this leads to a higher number of additional appointments and presents limitations as a COVID-19 surveillance technique. Merely counting suspected cases does not offer a clear insight into the interactions between COVID-19 patients and PHC personnel, as these interactions may also be due to other respiratory illnesses. Nevertheless, variations in the frequency of contacts with PHC can offer insights into the pandemic and its impact on PHC. Norway and UK have adopted an approach that includes sharing not only COVID-19 data but also the percentage of COVID-19 cases among all respiratory infections and the GP consultation rate per 100 000 population, which might serve as a more precise indicator

for understanding the COVID-19 pandemic's impact on regular PHC workloads.

The inclusion of PHC discharges as an indicator was suggested but not collected by any of the countries in the study,[35] rendering of limited utility. In this study, a variety of PHC indicators were identified, encompassing the total number of patients, contacts or procedures performed in PHC. Each dataset provides a different perspective that aids in better understanding the high workload in PHC during the pandemic. Norway and UK's approach, which includes sharing the percentage of COVID-19 cases among all respiratory infections and the GP consultation rate per 100 000 population, could serve as a more precise indicator for understanding the impact of COVID-19 on the regular PHC workloads. A comparative analysis of the total number of patients with hospitalized cases can help identifying which healthcare facilities requires reinforcement in response according to pandemic waves. Monitoring COVID-19 test referrals issued by GPs or the total number of tests performed can also serve as valuable indicators for PHC surveillance, as exemplified by Croatia. Tracking the total number of procedures in PHC, alongside data pertaining on specific procedures, can provide a comprehensive indicator of the overall workload in PHC. The Sentinelle GP network in France and Switzerland have established open data system, although it may not comprehensively represent virus circulation in the broader community, only among those who consult with their GP.[36,37] The establishment of a dashboard with new indicators could facilitate the monitoring of the pandemic and the COVID-19 workload in PHC.

Strengths and limitations

This study offers a significant contribution by being the first to describe COVID-19 indicators in PHC across Europe and analyze them. Furthermore, it provides insights into the availability of general COVID-19 surveillance data in 31 European countries. Nonetheless, certain limitations must be acknowledged. These include a reliance on raw data, which may necessitate adjustments based on population segments. The use of information collected from key-informants introduces the potential for bias. It is worth noting that, during the initial stages of the pandemic, many countries lacked testing capabilities, leading to an underestimation of COVID-19 cases. Moreover, testing policies varied among countries. The study's findings should be interpreted considering these limitations.

Implications for research and/or practice

To improve disease surveillance and the monitoring of PHC services burdens, more efforts are required to ensure the availability of open data concerning disease surveillance indicators, including those related to PHC. The mandatory implementation of disease coding systems in PHC, along with systematic data collection and recording, can facilitate the utilization of data for disease surveillance. Standardized minimum indicators should be agreed upon and embraced at both national and international levels. Consensus on defining PHC indicators should be achieved through a Delphi study. Investing in robust PHC information systems is crucial to identify weaknesses in the healthcare system and proposing strategies for better coordination among PHC hospitals, and public health.

Conclusions

The COVID-19 pandemic has revealed a critical gap in our preparedness for infectious disease outbreaks: the lack of consistent surveillance and workload indicators recording in PHC systems across European countries. This study underscores the pressing need for a standardized minimum set of infectious disease indicators to be implemented in PHC across all European nations. Furthermore, the importance of making these data accessible to the public cannot be overemphasized. These measures are essential for the development of an effective European-level response plan, providing a crucial framework for managing future pandemics while ensuring continuity of regular healthcare services.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Data availability

The data underlying this article are available in Supplementary file S3.

Ethics approval

The ethical approval was obtained from the Ethics Committee of the Hospital Universitario La Paz (Madrid, Spain), ID PI-5030. This ethical approval was provided to all the participants. Additional ethical approval according to local laws was needed in Croatia (Ethical approval from the Ethics committee, School of Medicine, University of Zagreb: Ur. Broj: 380-59-10106-22-111/76; Klasa: 641-01/22-02/01).

Key points

- Fourteen out of 31 countries gathered PHC data on COVID-19 patients with high heterogeneity among indicators, which difficult comparison among countries.
- Most of the indicators collected in PHC are related to the number of appointments and follow-ups.
- There is a need of a common PHC COVID-19 set of indicators in Europe.

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