

Increased health problems among primary care patients after COVID-19 infection: a retrospective observational study

Dorota Szydlarska^{1,2} , Maciej Jewczak³, Marta Ciechomska⁴, Marcin Śniegowski⁴, Katarzyna Orlewska⁵, Ewa Orlewska⁵, Andrzej Śliwczyński¹

¹Department of Digital Medicine, Implementation and Innovation, National Medical Institute of the Ministry of the Interior and Administration, Warsaw, Poland

²Department of Family Medicine, Medical University of Warsaw, Poland

³Department of Spatial Econometrics, Faculty of Economics and Sociology University, Łódź, Poland

⁴National Medical Institute of the Ministry of the Interior and Administration, Warsaw, Poland

⁵Collegium Medicum Jan Kochanowski University, Kielce, Poland

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Abstract

Introduction: Primary care physicians play a central role in the management of patients presenting with persistent or new symptoms after COVID-19 infection. Inadequate recording of long-COVID-related conditions in electronic health records and variability in ICD-10 coding practices hinder accurate epidemiological assessment and planning of primary care resources.

Aim of the research: To characterize health problems recorded in primary care after COVID-19 infection, assess diagnostic trends between 2018–2024, and compare ICD-10 category dynamics before and after the pandemic.

Material and methods: A retrospective observational study was conducted using anonymised electronic medical record data from 11 primary healthcare facilities reporting to the CliniNET system. The analysis included 68,926 unique adult patients with at least one ICD-10 diagnosis from predefined categories. Temporal trends and differences between the pre-pandemic (2018–2020) and post-pandemic (2021–2024) periods were evaluated.

Results: A total of 249,582 patient-events were analyzed. The most frequent ICD-10 categories were type 2 diabetes (E11), dyslipidaemia (E78), and spondylosis (M47). Between the two analyzed periods, the number of patients increased by 39% (from 102,343 to 141,977). The highest proportional increases were observed for E16, E79, T78, J98, and F03. Metabolic, cardiovascular and musculoskeletal conditions accounted for the majority of patient visits.

Conclusions: The study demonstrates substantial post-pandemic increases in several ICD-10 diagnostic groups and highlights the need for consistent coding practices to ensure appropriate clinical management, resource planning and epidemiological monitoring. Accurate post-COVID documentation and thorough clinical interview remain essential in primary care.

Introduction

Primary care physicians play a key role in managing patient access to healthcare. The COVID-19 pandemic has transformed healthcare access, providing primary care professionals with additional tools for communicating with patients, particularly the ability to communicate remotely via audio and video communication during teleconsultations. The crucial role of primary care physicians was in the care of patients who have recovered from COVID-19 and present with new symptoms or exacerbations of existing ones. These patients can be referred to as post-COVID syndrome (PCS) patients. The lack of a definitive, comprehensive PCS test dictates that initial diagnosis and treatment coordination are based on patient-reported symptoms [1, 2]. Diagnosis relies on clinical assessment and patient history due to the lack

of established criteria for long COVID [1, 3]. Typical PCS symptoms include fatigue, shortness of breath, and cognitive impairment, which should be assessed before making an alternative diagnosis [4–7]. Previous studies of the PCS population focused on hospitalized patients, but recent studies have expanded to non-hospitalized populations, revealing a significant prevalence of symptoms in primary care settings [8, 9]. Long-term consequences of COVID-19 can significantly affect patients' daily functioning [10–13]. The specific issue addressed in this review is characterizing and understanding the increased health problems in primary care patients after COVID-19 infection, particularly among those not requiring hospitalization. Despite growing evidence, a knowledge gap remains regarding the symptom prevalence, risk factors, and overlap of long COVID symptoms with common primary care complaints [6, 7, 14]. Contro-

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versy exists regarding symptom specificity, with some studies reporting high symptom prevalence in both SARS-CoV-2-positive and SARS-CoV-2-negative patients, which might additionally complicate the diagnosis. Additionally, inadequate recording of long COVID in primary care electronic health records and variability in clinical coding practices hinder accurate epidemiological assessment (lack of an appropriate, designated ICD-10 code). This gap has significant implications, including challenges in resource allocation and patient management in primary care.

Aim of the research

The aim of this study was to characterize the profile of primary care patients who developed health problems after COVID-19 infection, to assess diagnostic and epidemiological trends between 2018 and 2024, and to compare ICD-10 diagnostic dynamics before and after the pandemic.

Material and methods

This was a retrospective observational study using real-world data derived from secondary analysis of anonymized electronic medical records (EMR) extracted from the CliniNET clinical database maintained by the State Medical Institute of the Ministry of Interior and Administration. The study covered routinely collected data from 11 primary care facilities located in multiple cities and spanned the period 2018–2024. No formal sample size calculation was required due to the population-based nature of the dataset, which included all eligible primary care patients from 11 facilities over the 2018–2024 period. All data originated from the CliniNET (CGM) electronic record ecosystem. Prior to extraction, the Institute's standard anonymization workflow was applied, ensuring the complete removal of identifiable informa-

tion. All individuals with at least one encounter coded with an ICD-10 diagnosis from Attachment 1, or with post-COVID U-codes listed in Table 1, between 2018 and 2024 were included. Records limited to administrative contacts or isolated trauma codes were excluded. We counted unique patients for each 3-character ICD-10 category across the entire observation period. A patient could contribute to multiple categories but was counted at most once within a given category. Both primary and secondary diagnoses were included. Results are presented in descending order by the number of patients per code. To minimize potential sources of bias, uniform inclusion and exclusion criteria were applied across all facilities. Coding inconsistencies and under-registration of post-COVID conditions were identified as the most probable sources of bias, inherent to retrospective electronic health record (EHR)-based studies. No imputation of missing values was performed, and all analyses were based on available complete cases.

Key variables included demographics (age, sex), ICD-10 diagnostic groups, annual counts, and facility-level metrics. A “patient-visit” was defined as a unique co-occurrence of the pair (patient identifier; ICD-10 code) during a single encounter.

From all eligible facilities, age, sex, year, facility identifier, and ICD-10 codes were extracted. Duplicate technical entries were collapsed to unique encounters. Non-informative administrative records were removed. The final dataset consisted of 68,926 unique patients and 249,582 patient-events. All eligible records were included, without sampling. Study size was determined by availability of routine clinical data. To minimize potential sources of bias, standardized inclusion and exclusion criteria were applied across all primary care facilities. The main potential sources of bias included: (1) under-registration of post-COVID conditions due to the absence of specific ICD-10 codes in earlier years; (2) variability in diagnostic coding practices between facilities, which may introduce misclassification; and (3) incomplete clinical information inherent to retrospective electronic health record data. The dataset did not contain systematically missing values for key demographic or diagnostic variables. Records with incomplete identifiers, non-informative administrative entries or technical duplicates were excluded during the pre-processing stage. No imputation of missing values was performed; all analyses were carried out on complete available cases.

Descriptive statistics were used for demographic and diagnostic distributions. Group comparisons for age by sex employed median tests and the Mann-Whitney *U* test (Figure 1). Temporal trends were evaluated using annual percentage change, coefficients of variation, and Pearson correlation. Analyses were performed using IBM SPSS Statistics 20.

Table 1. Analyzed ICD-10 codes related to COVID-19

ICD-10 code	ICD-10 code name
U07.1	COVID-19 identified
U07.2	COVID-19 not identified
U08	Patient's history of COVID-19
U08.9	Patient's history of COVID-19, unspecified
U09	Patient health after COVID-19
U09.9	Patient's health after COVID-19, unspecified
U10	COVID-19-associated multisystem inflammatory syndrome
U10.9	COVID-19-associated multisystem inflammatory syndrome, unspecified

Results

The retrospective analysis was based on depersonalized data from a group of 68,926 individuals, each of whom had a diagnosis from Table 1. The flow of participants is shown in Figure 2. From all electronic medical records initially extracted from the ClinINET system, administrative entries and technical duplicates were removed during pre-processing, resulting in a final analytic cohort of 68,926 unique patients included in the study.

The time variable necessitated the use of the term “patient-visit”, which denotes the simultaneous occurrence of the pair “patient identifier + ICD-10 diagnosis” (the same diagnosis) in the data. Adopting this term resulted in the analysis of 249 582 patient-events. The characteristics of the analyzed group of patients considering gender and age are presented in Table 2. The median age of patients was 69 years, with a difference of 1 year between women and men (women median age 70 years; men median age 69 years). The Mann-Whitney *U* test was used to assess the consistency of age distribution. Both the test for equality of medians and the Mann-Whitney *U* test indicate different median age values and a different distribution of patient visits by gender. There were more women (58.2%) than men (41.8%) in the study group. However, it should be recognized that the analyzed population was relatively balanced with respect to gender. A change in dynamics was observed in the years 2018–2024, with a tendency for the number of patients to decrease, particularly in certain age groups (Figure 3). Table 3 summarizes the number and proportion of pa-

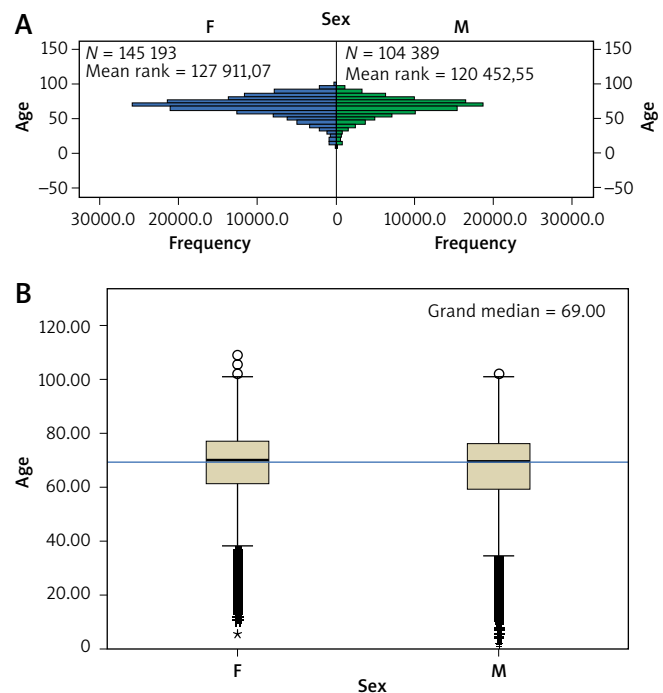


Figure 1. Statistical tests: **A)** Mann-Whitney *U* test, **B)** median test

tients assigned to each ICD-10 three-character category in the full cohort. Metabolic disorders (E11, E78), musculoskeletal conditions (M47, M15), and cardiovascular diseases (I50, I49, I70) were the most common diagnosis groups. Cumulative percentages indicate that the ten most frequent ICD-10 categories account for over 69% of all patient diagnoses.

Table 2. Characteristics of the analyzed population

	2018				2019				2020			
	F		M		F		M		F		M	
	N	Med.	N	Med.	N	Med.	N	Med.	N	Med.	N	Med.
Participation	22277	67.00	15745	67.00	21572	68.00	15151	67.00	16417	68.00	12070	68.00
	58.60%		41.40%		58.70%		41.30%		57.6%		42.40%	
	2021				2022				2023			
	F		M		F		M		F		M	
	N	Med.	N	Med.	N	Med.	N	Med.	N	Med.	N	Med.
Participation	21151	69.00	14743	68.00	16876	70.00	11690	69.00	10932	71.00	8095	70.00
	58.90%		41.10%		59.10%		40.90%		57.50%		42.50%	
	2024											
	F		M									
	N	Med.	N	Med.								
Participation	35968	72.00	26895	0	70.00							
	57.20%		42.80%									

N – count, Med. – median age, F – female, M – male

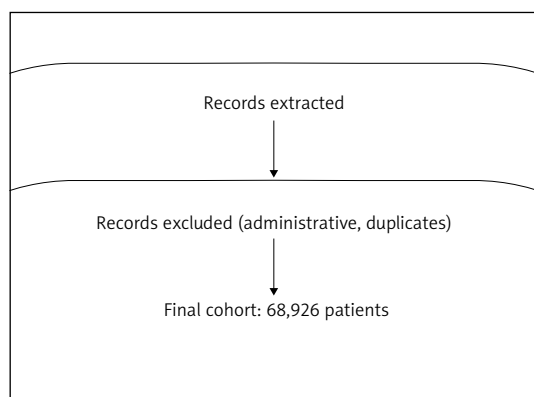


Figure 2. Flow of participants through the study

A comparison of the two periods selected for analysis, 2018–2020 vs. 2021–2024, shows a 39% increase in the number of patients in the comparable periods, from 102,343 patients in 2018–2020 to 141,977 in 2021–2024. The average annual number of patients in the analyzed period (2018–2024) was at the level of 34,903 patients, which translates into a relative variability of the series measured by the coefficient of variation $V_s = 35.02\%$, within the range of 25–45% for average variability, meaning moderate variability. Figure 4 presents the distribution of patient visits and their comparison by period and diagnosis group. The largest numerical increase in patient visits in the 2021–2024 period was observed for following ICD-10 codes:

- E78 – disorders of lipoprotein metabolism and other lipidemias (+9.2 thousand patient visits);
- E11 – type 2 diabetes (+6.6 thousand patient visits);
- I49 – ventricular fibrillation (+1.6 thousand patient visits);
- N40 – prostatic hyperplasia (+1.5 thousand) patient visits);
- M47 – spondylosis (+1.4 thousand patient visits);
- E03 – other hypothyroidism (+1.4 thousand patient visits).

The least numerous in terms of patient visits, but with an increase in the number of patient visits in the 2021–2024 period was observed for following ICD-10 codes:

- E88 – other metabolic disorders (+7 patient visits);
- E83 – mineral metabolism disorders (+12 patient visits);
- E84 – polycystic fibrosis (+13 patient visits);
- G50 – trigeminal nerve disorders (+23 patient visits);
- E87 – other disorders of water-electrolyte and acid-base balance (+24 patient visits);
- G62 – other polyneuropathies (+44 patient visits).

Figure 5 illustrates the relative change (“dynamics”) in the number of patient visits between the two analyzed time periods, 2018–2020 and 2021–2024, across all three-character ICD-10 diagnostic categories.

The figure presents the ratio of patient counts in the post-pandemic period to the pre-pandemic period, allowing identification of diagnostic groups with the greatest proportional increases. The highest dynamics were observed for E16 (Other disorders of pancreatic endocrine function), E79 (Purine and pyrimidine metabolism disorders), T78 (Adverse effects, not elsewhere classified), J98 (Other respiratory disorders), and F03 (Unspecified dementia), each showing several-fold increases. The figure highlights diagnostic areas in which the post-COVID period was associated with disproportionate growth compared to the preceding years, indicating potential shifts in disease patterns, care-seeking behavior or coding practices in primary care. Figure 6 illustrates the 20 most frequent ICD-10 categories in the cohort, showing that metabolic, lipoprotein, musculoskeletal and cardiovascular disorders represent the largest diagnostic burden in primary care:

- E16 – other disorders of pancreatic endocrine function (459.62%);
- E79 – disorders of purine and pyrimidine metabolism (433.90%);
- T78 – adverse effects, not elsewhere classified (including anaphylactic shock due to food reaction) (356.52%);
- J98 – other respiratory distress syndromes (242.06%);
- F03 – unspecified dementia (219.74%).

The smallest increases were observed for the following ICD-10 codes:

- M19 – other joint degenerations (13.33%);
- E04 – other non-toxic goiter (15.14%);
- M47 – spondylosis (16.13%);
- I50 – heart failure (17.35%);
- M15 – polyarthrosis (17.8%).

The distribution of patient visits in the specified primary healthcare facilities is listed in Table 4. Overall, the average annual increase in the number of patient visits was 8.89%. Not all analyzed primary healthcare facilities saw an upward trend in 2018–2024. Of note were the Woloska Primary Healthcare Center for Children, which recorded an average decline in patient visits of 10.63%, and the Woloska Primary Healthcare Center Polyclinic, with an average rate of change of -5.51% . Pearson’s correlation coefficient was used for this purpose, yielding values of 0.21 and 0.48, respectively, which may provide additional insights into planning future demand for services in the analyzed facilities. For the remaining primary healthcare facilities, the trends in patient visits were consistent, reaching approximately 80% or more, except for Primary Healthcare Frascati, which, although recording an average annual rate of change of $i_g = 0.86\%$, achieved a level of concordance of 0.67%. Looking at the highest values of average annual changes, one can distinguish Primary Healthcare Facility Ciechanów, which showed a +30.31% rate of change, maintaining

Table 3. Number of patients by ICD-10 category (3-character level), full cohort

ICD-10 (3-char)	ICD-10 title (EN)	Patients (n)	% of all patient-events	Cumulative %
E11	Type 2 diabetes mellitus	46 555	18.65	18.65
E78	Disorders of lipoprotein metabolism and other lipidemias	35 159	14.09	32.74
M47	Spondylosis	18 726	7.50	40.24
E03	Other hypothyroidism	15 685	6.28	46.53
I50	Heart failure	13 242	5.31	51.83
N40	Hyperplasia of prostate	11 549	4.63	56.46
M15	Polyarthrosis	11 424	4.58	61.04
K21	Gastro-esophageal reflux disease	8 445	3.38	64.42
I49	Other cardiac arrhythmias	7 316	2.93	67.35
I70	Atherosclerosis	5 382	2.16	69.51
M51	Other intervertebral disc disorders	5 206	2.09	71.60
M17	Gonarthrosis [arthrosis of knee]	4 700	1.88	73.48
M10	Gout	3 973	1.59	75.07
R68	Other general symptoms and signs	3 571	1.43	76.50
M16	Coxarthrosis [arthrosis of hip]	3 305	1.32	77.83
M54	Dorsalgia	3 277	1.31	79.14
D50	Iron deficiency anemia	3 181	1.27	80.41
R05	Cough	2 923	1.17	81.58
K63	Other diseases of intestine	2 720	1.09	82.67
L30	Other dermatitis	2 572	1.03	83.70
I83	Varicose veins of lower extremities	2 518	1.01	84.71
N18	Chronic kidney disease	2 152	0.86	85.58
F48	Other neurotic disorders	2 103	0.84	86.42
E04	Other nontoxic goiter	2 032	0.81	87.23
F33	Recurrent depressive disorder	1 731	0.69	87.93
M25	Other joint disorders, not elsewhere classified	1 692	0.68	88.60
E66	Obesity	1 649	0.66	89.26
R73	Elevated blood glucose level	1 622	0.65	89.91
K57	Diverticular disease of intestine	1 468	0.59	90.50
M19	Other and unspecified osteoarthritis	1 453	0.58	91.08
E74	Other disorders of carbohydrate metabolism	1 451	0.58	91.67
F51	Nonorganic sleep disorders	1 419	0.57	92.23
K76	Other diseases of liver	1 164	0.47	92.70
G47	Sleep disorders	1 077	0.43	93.13
K52	Other noninfective gastroenteritis and colitis	1 034	0.41	93.55
K59	Other functional intestinal disorders	979	0.39	93.94
L40	Psoriasis	929	0.37	94.31
R79	Other abnormal findings of blood chemistry	872	0.35	94.66
R53	Malaise and fatigue	826	0.33	94.99

Table 3. Cont.

ICD-10 (3-char)	ICD-10 title (EN)	Patients (n)	% of all patient-events	Cumulative %
E79	Disorders of purine and pyrimidine metabolism	768	0.31	95.30
D22	Melanocytic naevi	767	0.31	95.61
D64	Other anemias	737	0.30	95.90
F41	Other anxiety disorders	733	0.29	96.20
N31	Neuromuscular dysfunction of bladder, not elsewhere classified	674	0.27	96.47
R29	Other symptoms and signs involving the nervous and musculoskeletal systems	664	0.27	96.73
F03	Unspecified dementia	638	0.26	96.99
H90	Conductive and sensorineural hearing loss	626	0.25	97.24
M23	Internal derangement of knee	575	0.23	97.47
I87	Other disorders of veins	574	0.23	97.70
J98	Other respiratory disorders	571	0.23	97.93
R19	Other symptoms and signs involving the digestive system and abdomen	564	0.23	98.15
R91	Abnormal findings on diagnostic imaging of lung	533	0.21	98.37
D51	Vitamin B12 deficiency anemia	532	0.21	98.58
E55	Vitamin D deficiency	526	0.21	98.79
G45	Transient cerebral ischemic attacks and related syndromes	477	0.19	98.98
E16	Other disorders of pancreatic internal secretion	388	0.16	99.14
T78	Adverse effects, not elsewhere classified	387	0.16	99.29
F06	Other mental disorders due to brain damage and dysfunction and to physical disease	366	0.15	99.44
J84	Other interstitial pulmonary diseases	307	0.12	99.56
G62	Other polyneuropathies	227	0.09	99.65
G98	Other disorders of nervous system, not elsewhere classified	215	0.09	99.74
R32	Unspecified urinary incontinence	201	0.08	99.82
E87	Other disorders of fluid, electrolyte and acid-base balance	138	0.06	99.87
G50	Disorders of trigeminal nerve	107	0.04	99.92
E83	Disorders of mineral metabolism	91	0.04	99.95
E84	Cystic fibrosis	78	0.03	99.99
E88	Other metabolic disorders	36	0.01	100.00

a 0.88 level of concordance, and Primary Healthcare Facility Radom, which was the most stable in terms of patient visits, recording an average annual growth of 0.60% between years 2018 and 2024. There is no doubt that 9 of the 11 analyzed primary healthcare

facilities recorded a decline in the number of patient visits in 2023, compared to 2022, which rebounded in the following calendar year, indicating an increase in patient visits in each primary healthcare facility, when the total number of patients practically tripled.

The two outlying primary healthcare facilities are POZ Sandomierska and Siedlce, which recorded an approximately 11% increase in the number of patient visits in the analyzed period. We share data on request.

Discussion

The lack of dedicated ICD-10 codes for long COVID or post-COVID conditions in electronic medical records significantly complicates retrospective analyses of electronic data. The ICD-10 codes selected for data extraction in this article appear as principal diagnoses or, especially in primary care settings, as comorbid diagnoses for diseases previously or currently diagnosed as the primary cause. Over 30 studies used in this article indicated that shortness of breath, cognitive impairment, sleep disorders, and neuropsychiatric symptoms are the symptoms most frequently reported by patients [6, 8, 15]. Related reported symptoms may also include gastrointestinal, cardiovascular, and sensory changes [7, 16, 17]. Variability in symptom prevalence is influenced by hospitalization status, demographic factors, and time since infection, with non-hospitalized patients exhibiting overlapping symptoms with common primary care complaints [6, 18]. A comprehensive synthesis of these themes, including the strengths and weaknesses of current evidence across prevalence, diagnostic challenges, healthcare utilization, patient experience, management strategies, risk factors, and methodological limitations, is summarized in Attachment 2. Consistent findings show a higher long-term risk of COVID among women, middle-aged adults, and individuals with pre-existing comorbidities such as asthma, obesity, and mental health conditions [19, 20]. Vaccination is associated with a reduced frequency and severity of post-COVID conditions and lower healthcare utilization [21]. Appropriate coding of long COVID is crucial for monitoring the scale of the problem, conducting epidemiological studies, and planning healthcare resources. Further work is needed to refine diagnostic criteria and harmonize recommendations for the use of ICD-10 and ICD-11 codes to improve data quality and enable comparability of international research results. ICD-10 recommends coding post-COVID symptoms using the code U09.9 – post-COVID-19 condition. This code was introduced

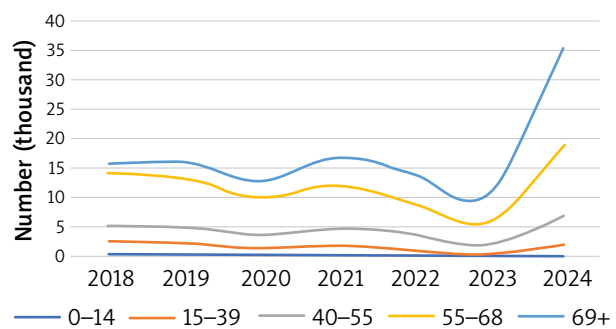


Figure 3. Number of patients by age in each year of follow-up

to enable the identification and monitoring of post-COVID-19 syndrome cases, but its general nature limits the ability to precisely classify individual clinical phenotypes. In clinical practice, it is often necessary to simultaneously code both U09.9 and additional codes describing the predominant symptoms (e.g. G93.3 for chronic fatigue, R06.0 for dyspnea, or F06.7 for mild cognitive impairment). ICD-11 partially addresses this issue through greater classification flexibility and the ability to assign multiple associated codes. The recommended code is RA02 – post-COVID-19 condition, which can be combined with codes describing specific clinical manifestations. This approach facilitates more accurate epidemiological characterization of patients and planning of healthcare services. However, interpretation difficulties remain: there is no clearly established period after which symptoms should be considered “post-COVID” (most often, ≥ 12 weeks after the acute phase of infection is considered), and there is no consensus on the range of symptoms that should be attributed to this syndrome. The mere fact that symptoms are “post-COVID” does not imply the existence of a specific treatment (currently, there is no single causal therapy, although in acute inflammatory syndromes, a clear association with COVID is crucial: it allows for the initiation of immunomodulation). However, a documented association with previous COVID-19 is important for guiding diagnosis and care planning:

- post-COVID patients are more likely to undergo cardiological (echocardiography, Holter, magnetic resonance imaging), pulmonary assessments (spirometry, stress tests, high-resolution computed to-

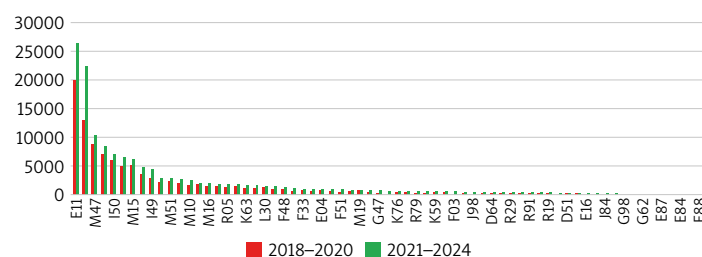


Figure 4. Distribution of the number of patient visits in both studied periods, taking into account the diagnosis group

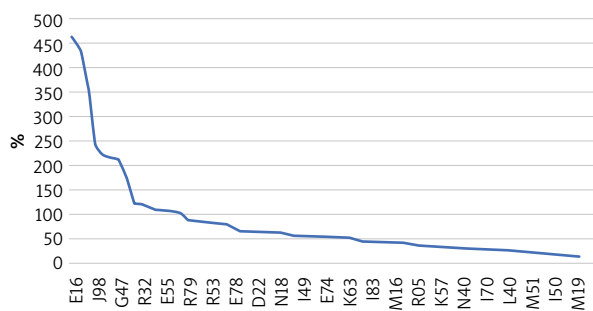


Figure 5. Dynamics of “2021–2024” vs. “2018–2020”

mography), neurological, psychiatric, and endocrinological evaluations;

- post-COVID rehabilitation or to specialist clinics.

Correct coding of post-COVID cases is crucial both at the clinical and systemic levels. Accurate documentation allows for the identification of a patient's symptoms as related to a past SARS-CoV-2 infection, facilitating further diagnosis and treatment. Differentiation from other illnesses allows for the separation of post-COVID symptoms from, for example, chronic diseases that might be coded differently. Correct coding also facilitates the transfer of information between physicians of different specialties and within different facilities. Correct coding allows for the assessment of how many patients experience post-COVID syndrome, the most common symptoms and complications, and correctly collected data provides the basis for epidemiological and clinical studies, as well as the assessment of treatment effectiveness. Correct post-COVID coding also impacts healthcare system resource planning: it enables the assessment of demand for post-COVID clinics, respiratory re-

habilitation, and psychiatric and psychological support. Code-based epidemiological data inform decisions by ministries and healthcare organizations regarding funding for post-COVID rehabilitation and educational campaigns. The international aspect is also important: uniform coding across countries enables global analysis and the development of shared recommendations. A crucial clinical observation is the significant increase in the number of patient visits in primary care with a diagnosis of E78 and E11. A bidirectional relationship has been shown between COVID-19 and diabetes [22]. On the one hand, people with diabetes are at higher risk of developing complications in case of COVID-19, and on the other hand, SARS-CoV-2 may act as a diabetogenic factor by binding to ACE2 in pancreatic beta cells, causing acute dysfunction and impaired glycemic regulation. Diabetes is one of the most common comorbidities in people with COVID-19, with its prevalence ranging from 7 to 30% [23]. People with diabetes infected with SARS-CoV-2 have a higher rate of hospitalization, severe pneumonia, and higher mortality compared to people without diabetes. Furthermore, diabetes is associated with chronic low-grade inflammation, which promotes the development of an excessive inflammatory response and thus the occurrence of acute respiratory distress syndrome. Recent evidence suggests that SARS-CoV-2 may also cause direct damage to the pancreas, which may exacerbate hyperglycemia and even induce diabetes in previously non-diabetic individuals [24]. Glycemic control and comorbidities must be individualized to reduce the incidence of complications and reduce the burden on healthcare systems. Given the multi-facility structure of the dataset, which includes primary care centers from vari-

Table 4. Distribution of patient visits between facilities

Institution	2018	2019	2020	2021	2022	2023	2024	Medium-term pace of change	Degree compliance r_{xy}
Primary Health Care Wołoska	7532	7032	4911	5041	4081	2132	5362	−5.51%	48%
POZ Ciechanów	2166	2580	2798	3915	3527	2244	10605	30.31%	88%
POZ for children Wołoska	159	145	86	187	112	22	81	−10.63%	21%
POZ POP	1834	1884	1728	1942	1470	592	4162	14.63%	98%
POZ Płońsk	1281	1246	1177	1495	1092	1046	3648	19.06%	93%
POZ Sandomierska	4988	4803	2706	5451	4550	5050	11688	15.25%	87%
POZ Pułtusk	1259	1154	1048	1040	805	367	2457	11.79%	99%
POZ Radom	10799	9142	8622	10113	7196	3374	11191	0.60%	78%
POZ Siedlce	3719	4125	2369	2632	2510	2802	7929	13.45%	92%
POZ Frascati	2337	2616	1877	2451	2072	864	2460	0.86%	67%
POZ Ostrołęka	1360	1428	739	1212	876	411	2828	12.98%	99%

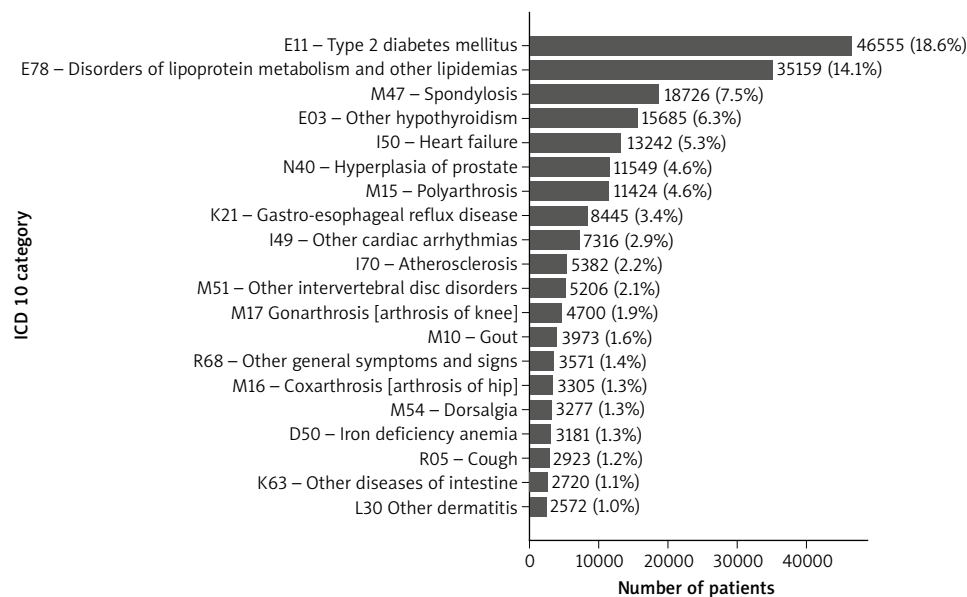


Figure 6. Top 20 ICD-10 categories by number of patients

ous regions and population types, the results of this study are likely generalizable to publicly funded Polish primary care settings. However, generalizability may be limited for private-sector practices, specialist clinics or healthcare systems with different coding standards, electronic health record structures, or patient demographics.

Limitations of the study

This study has several limitations inherent to retrospective EHR-based analyses. First, the lack of dedicated ICD-10 codes for long-COVID may have resulted in under-registration of post-COVID conditions. Second, coding practices varied between facilities, potentially introducing misclassification. Third, the observational study design precludes causal inference. Finally, unmeasured confounders such as lifestyle factors, socioeconomic status, or vaccination history were not available in the dataset.

Conclusions

Correct post-COVID coding is not just an administrative formality – it is crucial for the patient (continuity and adequacy of care), for the physician (facilitates diagnosis and documentation), for the healthcare system (resource planning, reimbursements), and for science (collecting reliable epidemiological data). An in-depth medical interview is particularly important for patients who have had COVID-19.

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Ethical approval

Not applicable.

Conflict of interest

The authors declare no conflict of interest.

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Address for correspondence:

Dorota Szydłarska
Department of Digital Medicine, Implementation
and Innovation
National Medical Institute of the Ministry of the Interior
and Administration
37 Wołoska St.
02-507 Warsaw, Poland
e-mail: dorota.szydłarska@cskmswia.gov.pl

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