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Pediatric neuropsychiatric consultations in the emergency department: a six-year analysis from a large Italian hospital (2019–2024)

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Abstract

Background.

Pediatric emergency department (PED) visits for neuropsychiatric reasons have risen markedly across high-income countries, with the COVID-19 pandemic acting as both a disrupting and amplifying factor. Within the integrated Italian Child and Adolescent Neuropsychiatry (CAP) model, where neurological and psychiatric concerns are managed by a single specialist team, longitudinal evidence covering both the pre-pandemic baseline and the post-emergency phase remains limited. We described six-year trends, seasonal patterns and clinical correlates of CAP consultations performed in the PED of a tertiary hospital in Northern Italy, applying multiple denominators to disentangle absolute and relative changes.

Methods.

Retrospective observational single-centre study of all CAP consultations performed in the PED of ASST Papa Giovanni XXIII, Bergamo, between 1 January 2019 and 31 December 2024 in patients aged 0–17 years. Records were classified by sex, age class, triage colour, clinical macro-category (neurological, psychiatric, neuro-psychiatric, inappropriate) and discharge disposition. Annual rates were standardised to total pediatric ED visits and to the 0–17 resident population of the province of Bergamo (ISTAT). Associations were tested with chi-square and Kruskal-Wallis tests; predictors of admission were modelled by multivariable logistic regression.

Results.

A total of 4,635 CAP consultations were analysed. After a 24% drop during the 2020 lockdown, absolute consultations rose to 954 in 2024 (+ 20% vs 2019). Standardisation by population revealed a larger 29% relative increase (from 41.1 to 53.0 per 10,000 residents aged 0–17 years), while the CAP-to-PED-visit ratio rose by 30% (from 31.7 to 41.1 per 1,000 visits). Females predominated overall (55.1%), with a peak of 56.8% in 2021. Consultations clustered in autumn–winter (peak in November) and dropped in summer (trough in August). In the logistic model (n = 4,635), red-code triage (OR 4.06, 95% CI 2.99–5.51) and psychiatric category (OR 1.39, 95% CI 1.04–1.85) independently predicted admission; the neuro-psychiatric category was associated with lower admission odds (OR 0.56, 95% CI 0.41–0.76). Median length of stay was 6 hours overall but 17 hours for red-code patients, with 9.9% of consultations exceeding 24 hours (boarding).

Conclusions.

Pediatric neuropsychiatric demand at the PED is rising disproportionately to overall PED activity and to a shrinking 0–17 population, with female adolescents disproportionately affected and substantial

boarding for high-acuity cases. Strengthening intermediate community services and PED boarding pathways is needed.

Background

Mental health emergencies among children and adolescents have become a major component of pediatric emergency department (PED) activity in most high-income countries [1–4]. National surveillance in the United States reported a 60% increase in pediatric mental health ED visits between 2007 and 2016, with rates of 14 per 1,000 children and adolescents per year and a marked predominance in females and adolescents aged 12–17 years [3]. In Europe and Canada, similar pre-pandemic trajectories have been confirmed in single- and multi-centre cohorts [5, 6]. The COVID-19 pandemic acted as both a disrupter and an accelerator of these trends: after an initial drop in overall PED attendance during lockdowns, mental health-related visits—particularly for self-injury, suicidal ideation, anxiety and eating disorders—rose sharply, often above pre-pandemic baseline [2, 7–10].

Italy followed a comparable trajectory. The Italian Society of Pediatrics (SIP) multicentre survey documented a + 84% increase in urgent neuropsychiatric consultations between March 2020 and March 2021 compared to the previous year, with disproportionate rises in suicidal ideation (+ 147%), acute depression (+ 115%) and eating disorders (+ 78%) [8]. Subsequent reports from individual hospitals confirmed that the post-pandemic phase has not been characterised by a return to baseline but rather by a new, higher equilibrium of demand [9, 11, 12].

In Italy, neurological and psychiatric care for minors is delivered by a single integrated specialty—Child and Adolescent Neuropsychiatry (Neuropsichiatria Infantile, CAP). When a child presents to the PED with a neurological, psychiatric or mixed problem, a single CAP consultant is called [13, 14]. This organisational feature shapes both the case-mix and the operational dynamics of the PED, but it also means that purely psychiatric trend reports from settings using a dual neurology/psychiatry model are only partially transferable to the Italian context.

Most published Italian PED series have focused on either psychiatric-only subsets [9, 11, 12] or restricted age groups (adolescents) [15], and the majority do not standardise temporal trends to denominators such as overall PED activity or the underlying resident population. In a context where the 0–17 resident population is in steady decline (around − 7% over six years in our province), counts of consultations may substantially understate the true relative increase in demand. Reporting standards for observational research using routinely collected data (STROBE-RECORD) explicitly recommend such standardisation [16, 17].

In this study we describe six years (2019–2024) of CAP consultations in the PED of ASST Papa Giovanni XXIII, Bergamo—the main tertiary referral hospital of one of the Italian provinces most severely affected by the first COVID-19 wave. The aims were: (i) to quantify trends in absolute counts and in rates standardised both to PED activity and to the 0–17 resident population; (ii) to characterise the case-mix by sex, age, triage acuity and clinical macro-category, including seasonal patterns; (iii) to identify

independent predictors of hospital admission, including indicators of ED operational burden such as length of stay. We hypothesised that the relative burden of CAP consultations on PED activity would rise across the period, that female adolescents would dominate the psychiatric and neuro-psychiatric strata, and that high-acuity triage and psychiatric diagnoses would independently predict admission.

Methods

Study design and setting

We conducted a retrospective observational single-centre study reported in accordance with STROBE [16] and adapted RECORD [17] guidance. The setting was the pediatric emergency unit of the ASST Papa Giovanni XXIII, Bergamo, a 1,117-bed tertiary teaching hospital and regional referral centre for pediatric trauma, organ transplantation, and high-complexity medical and surgical care in Northern Italy. The pediatric ED serves both the metropolitan area of Bergamo and a wider catchment that includes several mountain valleys (Val Brembana, Val Imagna, Val Seriana, Val Cavallina). All neuropsychiatric concerns in patients under 18 years—neurological, psychiatric, and mixed—are assessed by a single CAP consultation team.

Operational pathway.

At our institution, every pediatric patient presenting to the general ED is triaged using the regional pediatric triage protocol. Whenever a neurological or psychiatric symptom is documented, or when a triage red flag for self-harm or behavioural crisis is positive, the pediatric ED physician requests a CAP consultation. CAP specialists are available in person within the PED until 18:00 on weekdays and between 08:00 and 20:00 on Saturdays and public holidays; outside these hours, coverage for behavioural crises is provided by the on-call adult psychiatry service, while all other neuropsychiatric concerns are managed by on-call telephone consultation with the CAP team. Median response time for the CAP consultant during the study period was 35 minutes (IQR 18–62). Pharmacological management (anxiolysis, antipsychotic sedation) follows a shared protocol issued in 2019 and updated in 2022; physical restraint is rare (< 2% of consultations). When inpatient care is required, the hospital operates a functional model of shared beds across the pediatric and psychiatric wards rather than a dedicated CAP ward: high-acuity (red-code) patients older than 15 years are admitted to the psychiatric ward and younger patients are transferred to a regional adolescent inpatient unit, while all other admitted patients are hospitalised in the pediatric ward with continuous CAP consultation.

Population and data sources

Eligibility was age 0–17 years at PED presentation between 1 January 2019 and 31 December 2024. No further exclusions were applied. Records were extracted from the institutional ED information system and included demographics (sex, date of birth, district of residence), process variables (arrival mode,

triage colour, presentation and discharge timestamps, disposition), and primary and secondary diagnoses coded in ICD-9-CM.

Population denominators for the resident 0–17 group of the province of Bergamo were obtained from official ISTAT demographic tables (1 January estimates of each calendar year, post-2021 census reconciliation [18]). Annual totals of pediatric (0–17) ED visits at the institution were obtained from internal administrative records and represent the second denominator used to standardise CAP demand to overall PED activity.

Data preparation

All analyses were performed in R 4.4.1 (packages readxl, dplyr, stringr, lubridate, ggplot2, broom). Age was categorised as preschool (0–5), school (6–10) and adolescent (11–17). During the study period the Regione Lombardia paediatric triage protocol changed: until May 2023 a four-level system was in use (red, yellow, green, white), and from June 2023 it was replaced by a five-level numeric system (1-red, 2-orange, 3-light-blue, 4-green, 5-white). The 13 original textual descriptors recorded in the source system were harmonised across the two periods into six priority labels (red, orange, yellow, light-blue, green, white); for the pre-June-2023 period, yellow codes were mapped to orange (code 2) as a clinically equivalent priority class, and no light-blue code existed in the earlier system. Triage-stratified results should accordingly be interpreted with caution for the pre-2023 period. Diagnoses were grouped into four mutually exclusive clinical macro-categories using the three-digit ICD-9 prefix: neurological (ICD-9 320–389 plus specific codes for cerebrovascular, skull/neck trauma and structural CNS conditions), psychiatric (ICD-9 290–319 plus selected V-codes for poisoning, abuse and family stressors), neuro-psychiatric (somatoform-functional codes and shared codes indicating mind–body comorbidity), and inappropriate (codes outside the above ranges, e.g. otitis, sprains). The neuro-psychiatric macro-category aggregates ICD-9 codes that the clinical team systematically associates with mixed mind–body presentations: 780 (general symptoms, including syncope and unspecified somatic complaints), 784 (symptoms involving head and neck, predominantly headache), 564 (functional digestive disorders), 573 (other liver disorders, generally functional in children), 779 (perinatal and other unspecified conditions), 910 (superficial injuries / minor head trauma) and 947 (burns of internal organs and mucosae, often non-organic in adolescents). The most frequent codes within this category were 784 and 780. Our use of selected V codes (V61, V62, V71) within the Psychiatric category follows the convention used in previous Italian multicentre series (Bozzola et al., 2022), where stressors and dysfunctional family situations leading to acute mental health presentations are routinely included. A sensitivity re-analysis excluding the V codes from the Psychiatric category (–1.6% of the psychiatric stratum) did not materially affect the temporal trends or the multivariable model.

Statistical analysis

Categorical variables were summarised as absolute frequencies and percentages; continuous variables as median and interquartile range (IQR). Trends were analysed both as raw annual counts and as

standardised rates per 1,000 pediatric ED visits and per 10,000 residents aged 0–17 years. Bivariate associations between sex, triage, clinical category and outcome were tested with Pearson's chi-square; length-of-stay distributions were compared with the Kruskal-Wallis and Mann-Whitney tests. Because eight bivariate chi-square tests were performed across the sex × category, triage × category and triage × outcome strata, p-values for the bivariate analyses were also evaluated against a Holm-Bonferroni–adjusted threshold; all the associations reported as statistically significant in the Results survived this correction.

Independent predictors of hospital admission (binary outcome: admitted vs discharged) were estimated by multivariable logistic regression including triage colour (reference: green), age in years, sex (reference: female), clinical macro-category (reference: inappropriate) and time-to-first-visit in minutes. Collinearity was assessed by the Variance Inflation Factor; model fit by McFadden's pseudo-R^2 and discrimination by the AUC of the receiver operating characteristic curve. Two-sided p-values < 0.05 were considered significant. Full R code is provided as Supplementary Material.

Interrupted time-series analysis

To formally test for a structural change at the onset of the pandemic we modelled the 72-month time series of CAP consultations (January 2019 – December 2024) using a segmented quasi-Poisson regression with a log-population offset based on ISTAT 0–17 resident estimates for the province of Bergamo. The single intervention point was set at March 2020 (T = month 15), coinciding with the national lockdown. The model included a linear time trend, harmonic seasonal terms with period 12 and 6 months (sin/cos), a step (level-change) term and a slope-change term. Dispersion was estimated by the Pearson chi-square divided by the residual degrees of freedom. Residual autocorrelation was assessed by the Pearson residual autocorrelation function and the Ljung-Box test at lags 6 and 12. Effect estimates are reported as rate ratios (RR) with 95% confidence intervals. The reconstruction of monthly counts and the full R/Python code are available in Supplementary Material.

Ethics

The study used routinely collected, fully anonymised data for audit purposes. The local Ethics Committee granted exemption from informed consent (protocol no. 123/2025).

Results

Baseline characteristics

Between 1 January 2019 and 31 December 2024 a total of 4,635 CAP consultations were performed in patients aged 0–17 years (Table 1). Females accounted for 2,554 (55.1%) of consultations and the median age was 12 years (IQR 6–15); 2,763 (59.6%) consultations involved adolescents (11–17 years), 830 (17.9%) school-age children and 1,042 (22.5%) preschoolers. Most patients arrived autonomously

(52.9%) or by ambulance (34.0%). At triage, 45.5% were classified as green, 25.9% yellow, 13.1% orange and 4.8% red. Clinical macro-category was neurological in 36.7%, psychiatric in 25.6%, neuro-psychiatric in 24.3% and inappropriate in 13.4%. District-level residence was available for 4,273 (92.2%) records, mostly distributed across the Bergamo, Dalmine and Isola Bergamasca districts.

Table 1
Baseline characteristics of the study cohort (n = 4,635)

Variable	**n**	**%**
Female sex	2,554	55.1
Male sex	2,081	44.9
Age class — preschool (0–5 y)	1,042	22.5
Age class — school (6–10 y)	830	17.9
Age class — adolescent (11–17 y)	2,763	59.6
Arrival — self / private	2,450	52.9
Arrival — public ambulance (118)	1,574	34.0
Triage — red	222	4.8
Triage — orange	605	13.1
Triage — yellow	1,199	25.9
Triage — light blue	481	10.4
Triage — green	2,110	45.5
Triage — white	18	0.4
Clinical macro-category — neurological	1,700	36.7
Clinical macro-category — psychiatric	1,188	25.6
Clinical macro-category — neuro-psychiatric	1,128	24.3
Clinical macro-category — inappropriate	619	13.4

Percentages are calculated on the total cohort (n = 4,635). Adolescent age class dominates; female sex is over-represented overall.

Annual trends and the role of denominators

Annual CAP consultations dropped from 795 in 2019 to 606 in 2020 (−24%) during the COVID-19 lockdown phase, then increased steadily to 954 in 2024 (+ 20% versus 2019; +57% versus the 2020 trough) (Fig. 1A, Table 2). Standardisation by the total number of pediatric ED visits showed a steeper proportional rise: CAP consultations represented 31.7 per 1,000 pediatric ED visits in 2019, 44.2 in 2020

(when overall PED activity collapsed), and 41.1 in 2024—a 30% increase over the period (Fig. 1B). Standardisation by the resident 0–17 population of the province of Bergamo, which declined by 7.0% over the same period (from 193,658 to 180,166), revealed an even larger relative increase of 29%: from 41.1 per 10,000 residents in 2019 to 53.0 in 2024 (Fig. 1C). The combination of rising consultations and a contracting denominator therefore conceals, in absolute counts alone, the full magnitude of the relative increase in demand.

Table 2
Annual CAP consultations expressed against multiple denominators, 2019–2024

Year	CAP consultations (n)	Total pediatric ED visits (n)	Resident 0–17 population	CAP per 1,000 PED visits	CAP per 10,000 residents 0–17
2019	795	25,048	193,658	31.7	41.1
2020	606	13,704	190,951	44.2	31.7
2021	674	17,724	188,710	38.0	35.7
2022	742	22,704	185,543	32.7	40.0
2023	864	22,890	182,637	37.7	47.3
2024	954	23,191	180,166	41.1	53.0
Δ 2024 vs 2019	**+ 20%**	**–7.4%**	**–7.0%**	**+ 30%**	**+ 29%**

Total pediatric ED visits include all 0–17 presentations to the institution. Resident population estimates are ISTAT 1 January figures for the province of Bergamo. The compound effect of rising CAP demand and shrinking pediatric population means that the relative increase is substantially larger than the apparent absolute change.

Sensitivity analysis with a restricted denominator

To address the concern that the provincial population over-estimates the actual catchment of the pediatric ED, we re-computed the rates using only the three districts that contributed > 54% of the cohort (Bergamo, Dalmine, Isola Bergamasca; n = 2,529 / 4,635). The 0–17 ISTAT population of these districts was 90,517 in 2019 and 84,164 in 2024 (–7.0%, mirroring the provincial decline). For the sub-cohort, rates per 10,000 residents rose from 42.4 in 2019 to 56.3 in 2024 (+ 32.8%), confirming that the relative increase is, if anything, slightly larger when the denominator is restricted to the principal catchment districts.

Interrupted time-series analysis.

The segmented quasi-Poisson model (dispersion 0.97) is shown in Fig. 7. The pre-pandemic monthly trend was statistically flat (RR per year 0.92, 95% CI 0.76–1.11). In March 2020 the series exhibited an immediate, marked level drop (RR 0.755, 95% CI 0.655–0.870, $p < 0.001$), corresponding to an

approximately 24% reduction relative to the counterfactual. From March 2020 onward the underlying trend slope increased significantly (slope-change RR 1.243 per year, 95% CI 1.027–1.505, p = 0.026), yielding a post-intervention annualised trend of + 14.4% per year (RR 1.144, 95% CI 1.118–1.171). The cumulative effect of the upward slope change implies that by December 2024 the observed monthly count was approximately twice the counterfactual value (Fig. 7A). Some residual autocorrelation persisted (Pearson ACF lag 1 = 0.25, Ljung-Box p < 0.001 at lag 12), most likely reflecting waves of seasonal respiratory and gastrointestinal infections that propagate into the neuro-psychiatric category through somatoform and post-infectious presentations.

Sex distribution over time

Female predominance was present every year and ranged between 53.3% (2019) and 56.8% (2021), peaking during the immediate post-lockdown phase (Fig. 2). The 2024 distribution (55.7% female) closely reproduced the 2020 ratio, suggesting that the female-skewed pattern, magnified during the pandemic, has been preserved in the new equilibrium of demand.

Clinical case-mix and its evolution

The mix of clinical macro-categories shifted notably across the period (Fig. 3, Table 3). The neurological share fell to its lowest value in 2022 (29.0%), then climbed to 42.9% in 2024 in parallel with the absolute reactivation of neurological consultations (from 215 in 2022 to 409 in 2024). The psychiatric share peaked in 2021 (33.8%, n = 228), consistent with the well-documented post-lockdown surge of acute psychiatric presentations in adolescents [7, 8]. The neuro-psychiatric share, conversely, declined from 31.7% in 2019 to 20.0% in 2024. The inappropriate share remained between 11.6% and 14.6%.

Table 3
Annual distribution of CAP consultations by clinical macro-category

Year	Neurological n (%)	Neuro-psychiatric n (%)	Psychiatric n (%)	Inappropriate n (%)	Total
2019	245 (30.8)	252 (31.7)	183 (23.0)	115 (14.5)	795
2020	252 (41.6)	137 (22.6)	142 (23.4)	75 (12.4)	606
2021	237 (35.2)	131 (19.4)	228 (33.8)	78 (11.6)	674
2022	215 (29.0)	210 (28.3)	213 (28.7)	104 (14.0)	742
2023	342 (39.6)	207 (24.0)	189 (21.9)	126 (14.6)	864
2024	409 (42.9)	191 (20.0)	233 (24.4)	121 (12.7)	954

Macro-categories are mutually exclusive; row totals correspond to all CAP consultations recorded in the calendar year.

Seasonality

Pooling all six years, CAP consultations showed a strong seasonal pattern, with a clear summer trough (266 consultations in August, 289 in July) and an autumn peak (495 in November, 486 in October) (Fig. 4). The same pattern was present in each clinical macro-category: the November peak was particularly marked for neuro-psychiatric (n = 136) and neurological (n = 181) consultations, while October was the absolute peak for psychiatric presentations (n = 125). The inappropriate category had its highest month in February (n = 74). The seasonality therefore aligns with the school calendar and seasonal mood fluctuations described in pediatric and adult psychiatry [19].

Predictors of hospital admission

In the multivariable logistic regression (n = 4,635), all variance inflation factors were ≤ 1.44, indicating no relevant collinearity. McFadden's pseudo-R^2 was 0.182; discrimination, measured by the area under the receiver operating characteristic curve, was 0.789 (95% CI 0.770–0.808); the Hosmer–Lemeshow test did not indicate poor calibration ($\chi^2(8) = 9.4$, $p = 0.31$). Adjusting for all other predictors, red-code triage was associated with a fourfold higher odds of admission compared with green (OR 4.06, 95% CI 2.99–5.51, $p < 0.001$), with yellow and orange codes also independently predictive of admission (OR 1.84 and 1.60 respectively) (Fig. 5, Table 4). Each additional year of age reduced the odds of admission by 6% (OR 0.94, 95% CI 0.93–0.96, $p < 0.001$), and male sex was associated with lower admission odds compared to female (OR 0.84, 95% CI 0.72–0.99, $p = 0.039$).

Compared with inappropriate consultations, psychiatric presentations carried a 39% higher odds of admission (OR 1.39, 95% CI 1.04–1.85, $p = 0.027$). The neurological category was directionally similar (OR 1.34, 95% CI 0.71–1.79, $p = 0.024$); the lower bound below 1 invites a cautious reading, but the point estimate is fully consistent with the psychiatric category in indicating that organic neurological presentations also carry higher admission odds than presentations classified as inappropriate. The neuro-psychiatric category was independently associated with lower admission odds (OR 0.56, 95% CI 0.41–0.76, $p < 0.001$), consistent with the higher prevalence of functional/somatoform presentations in this stratum [20]. Longer time from registration to first medical examination was associated with marginally lower admission probability (OR 0.997 per minute, $p = 0.022$).

Table 4
Multivariable logistic regression — predictors of hospital admission (n = 4,635)

Predictor (reference category)	Adjusted OR	95% CI	p
Triage colour (ref: green)			
Red	4.06	2.99–5.51	< 0.001
Yellow	1.84	1.52–2.23	< 0.001
Orange	1.60	1.25–2.04	< 0.001
Light blue	0.93	0.68–1.26	0.63
White	1.09	0.31–3.86	0.89
Demographic variables			
Age (per year)	0.94	0.93–0.96	< 0.001
Male sex (ref: female)	0.84	0.72–0.99	0.039
Clinical macro-category (ref: inappropriate)			
Psychiatric	1.39	1.04–1.85	0.027
Neurological	1.34	0.71–1.79	0.024
Neuro-psychiatric	0.56	0.41–0.76	< 0.001
Process variable			
Time to first visit (per minute)	0.997	0.995–0.999	0.022

OR = adjusted odds ratio; CI = confidence interval. All variables included simultaneously. All VIF values were ≤ 1.44, indicating no collinearity concern. Reference categories: triage green; female sex; inappropriate macro-category.

Length of stay and boarding

Median length of stay (LOS) was 6.0 hours (IQR 4.0–17.0) for the whole cohort; the distribution was highly right-skewed (skewness 4.8). LOS rose with triage priority, from a median of 3.5 hours for white-code patients (n = 18) to 17.0 hours for red-code patients (n = 222), with 95th centiles up to 50 hours in the orange code (Fig. 6). Among 458 (9.9%) consultations exceeding 24 hours—the most commonly cited boarding threshold [21]—70% fell in red/orange/yellow strata and 61% ended with admission or transfer, suggesting that prolonged stays predominantly reflect inability to find an appropriate downstream bed rather than diagnostic uncertainty. Psychiatric cases accounted for 14% of stays > 24 hours, in line with the well-documented bottleneck of pediatric psychiatric beds in Italy [9, 11, 21, 22].

Discussion

This six-year, single-centre analysis of 4,635 CAP consultations performed at the PED of a major Italian tertiary hospital documents three findings of practical relevance for service planning. First, the absolute volume of CAP consultations rose by 20% between 2019 and 2024 (and by 57% versus the 2020 trough), but standardisation by either total pediatric ED activity (+ 30%) or the resident 0–17 population (+ 29%) reveals a substantially larger relative increase that would have been missed by looking at raw counts alone. Because the pediatric resident population in the province has been shrinking by approximately 7% over six years, the same number of consultations corresponds to a higher per-capita burden each year. Reporting both numerator and denominator dynamics is therefore not a methodological luxury but a precondition for an honest reading of the trend, as also emphasised by recent multicentre Italian analyses using interrupted time-series methods [11].

Second, the case-mix shifted in a pattern consistent with the COVID-19 hypothesis but with important nuances. The psychiatric share peaked in 2021—immediately after the most stringent lockdown phase—paralleling national SIP data on the sharp post-lockdown rise of psychiatric emergencies in Italian PEDs [8] and converging with results from Genoa [7], Rome [12] and Lombardy more broadly [9, 22]. The neuro-psychiatric share, conversely, fell across the period; this likely reflects both the absolute increase of unambiguously psychiatric presentations (which dilute the share of mixed cases) and a possible re-classification effect, with clinicians more readily assigning a psychiatric label after the cultural shift induced by the pandemic. The strong 2023–2024 resurgence of the neurological category (up 67% versus 2022, from 215 to 409) is harder to attribute to a single mechanism: post-pandemic neuroinfectious waves [11], delayed presentations of chronic neurological conditions, and post-COVID neurological sequelae have all been proposed but require further work to disentangle.

Third, the case-mix exhibits a robust female predominance every year (53–57%), and acuity-stratified outcomes confirm the international pattern: female adolescents, high-acuity triage codes and psychiatric diagnoses are independently associated with admission. The adjusted OR of 4.06 for red versus green triage is at the upper end of values reported in pediatric PED literature [3, 15], reflecting both the appropriateness of the triage system and the fact that the most severe presentations in our cohort overwhelmingly involve psychiatric crises and severe neurological events. The female predominance was driven by the adolescent stratum (where females accounted for approximately 64% of consultations) and was largely absent in the preschool stratum, where the sex distribution was balanced. This age-conditional pattern is consistent with international observations on the rise of internalising disorders, eating disorders and self-harm among adolescent girls [3, 7, 9, 22, 23], and with the early-adolescent age of onset of mood and anxiety disorders described in the global meta-analysis by Solmi et al. [24]. The lower admission odds observed for the neuro-psychiatric stratum (OR 0.56, 95% CI 0.41–0.76) deserve a clinical comment. This stratum predominantly comprises functional and somatoform presentations — chronic and acute headache, syncope of vasovagal type, functional abdominal pain, and pseudo-seizures, often co-occurring with anxiety in adolescents. Once organic differential diagnoses have been excluded by the CAP consultant, these presentations are typically managed with structured discharge planning, parental psycho-education and outpatient follow-up rather than inpatient admission. The decline of this stratum in absolute share over the period (from 31.7% in 2019 to 20.0% in 2024) is

therefore consistent with both an absolute increase of more clearly defined psychiatric and neurological presentations and a parallel decrease in the diagnostic ‘grey zone’ that functional codes traditionally occupy.

The fourth element worth highlighting is the substantial burden of boarding. With nearly 10% of consultations lasting more than 24 hours—and the great majority of these eventually requiring admission or transfer—the PED is acting as a holding environment for patients waiting for downstream beds that are not available. Pediatric mental health boarding has become a major operational and ethical concern across high-income systems [21, 27, 33]. The 17-hour median LOS we observed for red-code patients exceeds typical operational targets (4–8 hours for ED LOS in pediatric settings) by a factor of two to four; the 95th centile of 41–50 hours in red/orange-code strata signals an extreme tail of cases that are de facto receiving inpatient-equivalent care in an ED bay. In our hospital, the inpatient beds available for minors, shared across the pediatric and psychiatric wards rather than concentrated in a dedicated CAP ward, have been saturated since the post-2021 reactivation phase, so most prolonged stays reflect waiting for either a local bed to free up or a transfer to a regional inpatient psychiatric facility in Brescia, Milan or Pavia — a pattern consistent with the multicentre Lombardy findings of Clavenna et al. [22]. The boarding burden in our cohort, therefore, is structural rather than transient, and it is concentrated where clinical risk is highest. This is the same phenomenon described by the American Academy of Pediatrics and the American Academy of Child and Adolescent Psychiatry as a clinical and ethical priority [21, 25–27]. In our cohort, the median LOS of 17 hours for red-code patients (95th centile 41 hours) confirms that boarding is highest precisely where the clinical risk is greatest. The recent Italian literature suggests this is a structural, not transient, indicator of the mismatch between the demand for specialised inpatient psychiatric care for minors and the available offer [22, 28].

Implications for service organisation

Three implications follow. First, the integrated Italian CAP model—where the same specialist team manages neurological, psychiatric and mixed presentations—is well placed to absorb the increased complexity of the post-pandemic case-mix, but it does so by exposing a single team to escalating volumes. Strengthening this model, rather than fragmenting it into separate neurological and psychiatric pathways as in some Anglo-American systems, is likely to preserve the diagnostic flexibility needed for the growing share of mixed presentations [13, 14, 28]. Second, the boarding burden cannot be reduced by simply adding inpatient beds: it requires intermediate community resources such as crisis homes, day-hospital pathways and post-discharge follow-up to break the cycle of revolving-door PED revisits [25, 26]. Third, ED triage tools developed for general pediatric emergencies are increasingly insufficient for psychiatric crises: integrating a brief psychosocial risk component into the triage process, as recommended by the AAP joint policy statement [25], should be considered in Italian centres.

Strengths and limitations

The main strengths of this study are the six-year window, which spans pre-pandemic, pandemic and post-pandemic phases without interruption; the inclusion of every CAP consultation in the period without

selection criteria; and the use of multiple denominators—total pediatric ED activity and resident population—to express trends as rates and not only as counts. To our knowledge, this is one of the first Italian PED series to report all three denominators alongside the case-mix and to extend the analysis through 2024.

Several limitations should be acknowledged. First, the study is single-centre and retrospective; despite the hospital's role as a tertiary referral centre, generalisability beyond Northern Italian settings with an integrated CAP service should be cautious. Second, the resident 0–17 population of the province of Bergamo is an approximate denominator for the catchment of the PED, which extends beyond the provincial boundaries and may not uniformly cover the inner districts; the resulting rates may therefore slightly over-estimate the true population-level incidence. A sensitivity analysis restricted to the three districts that contribute > 54% of the cohort (Bergamo, Dalmine, Isola Bergamasca) yielded a comparable relative increase (+ 32.8% vs + 29%), suggesting that the directional inference is robust to the choice of denominator; a fully accurate analysis would, however, require linkage with anagraphic data not available for the present study. Third, the use of ICD-9 macro-categories collapses a fine-grained clinical reality into four buckets; misclassification, especially at the neurological–neuro-psychiatric boundary, is possible and may attenuate observed associations [29]. Finally, in line with STROBE-RECORD guidance [16, 17], all associations should be interpreted as descriptive and not causal: confounding by unmeasured factors (school calendar, regional reorganisation of mental health services, COVID-19 waves) is plausible.

Conclusions

Over the six years 2019–2024, demand for child and adolescent neuropsychiatric consultations at the PED of a large Italian tertiary hospital rose by 20% in absolute terms but by approximately 30% per pediatric ED visit and per 10,000 residents aged 0–17 years, in a context of a shrinking pediatric population. Female adolescents are the dominant demographic, and the case-mix has shifted toward a higher psychiatric share immediately after the COVID-19 lockdowns and a renewed neurological resurgence in 2023–2024. Hospital admission is independently driven by high-acuity triage and psychiatric diagnoses, while neuro-psychiatric (often functional) presentations carry lower admission odds. Nearly one in ten consultations now exceeds 24 hours of stay, a sign of structural boarding. These findings argue for preserving the Italian integrated CAP model, investing in intermediate community services and adapting PED triage tools to psychiatric crises.

Abbreviations

AUC
area under the curve
CAP
Child and Adolescent (Neuro)psychiatry
CI

confidence interval
ED
emergency department
ICD-9
International Classification of Diseases 9th revision
IQR
interquartile range
ISTAT
Italian National Institute of Statistics
LOS
length of stay
OR
odds ratio
PED
pediatric emergency department
RECORD
REporting of studies Conducted using Observational Routinely-collected health Data
SIP
Italian Society of Pediatrics
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
VIF
variance inflation factor.

Declarations

Ethics approval and consent to participate

The study used fully anonymised data extracted retrospectively for clinical audit purposes. The local Ethics Committee granted exemption from informed consent (protocol no. 123/2025). All procedures complied with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable. The manuscript does not include any individual person's data in any form.

Availability of data and materials

Aggregated, fully anonymised tables underlying every figure and table in this manuscript (annual counts and rates by sex, age group and clinical category; monthly reconstructed time series; logistic regression output) will be deposited on Zenodo upon acceptance and identified by a DOI. The complete analytical code (R and Python) is provided as Supplementary Material. The raw individual-level dataset cannot be

shared publicly under the institutional Data Protection policy but is available to qualified researchers on reasonable request and with permission of the ASST Papa Giovanni XXIII Data Protection Office and Ethics Committee.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

PM conceived the study, designed the methodology, performed clinical data extraction and curation, and drafted the manuscript. FR developed and executed all statistical analyses, including the interrupted time-series model, and generated all figures, tables and supplementary materials. AM and AG contributed to clinical data collection and verification, and assisted in the characterisation of the institutional setting and operational pathways. LV supervised the project from inception, provided senior clinical oversight as Director of the Paediatric Emergency Department, facilitated institutional data access, and critically revised the manuscript. PS, JG, RN and LD provided academic and scientific supervision, contributed to the interpretation of clinical findings, and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Figures

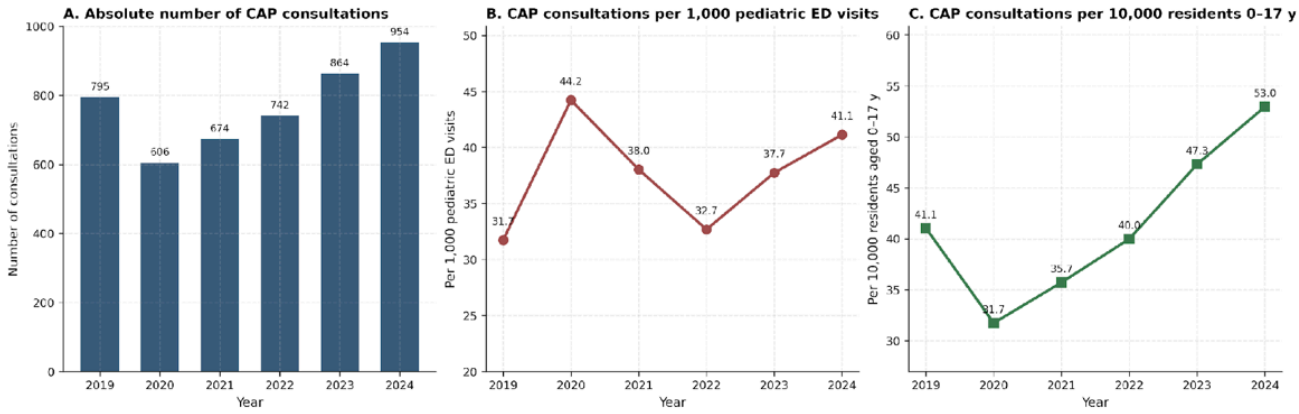


Figure 1

Six-year trend of CAP consultations at the pediatric ED. (A) Absolute annual counts; (B) consultations standardised per 1,000 pediatric ED visits; (C) consultations standardised per 10,000 residents aged 0–17 years in the province of Bergamo (denominators from ISTAT).

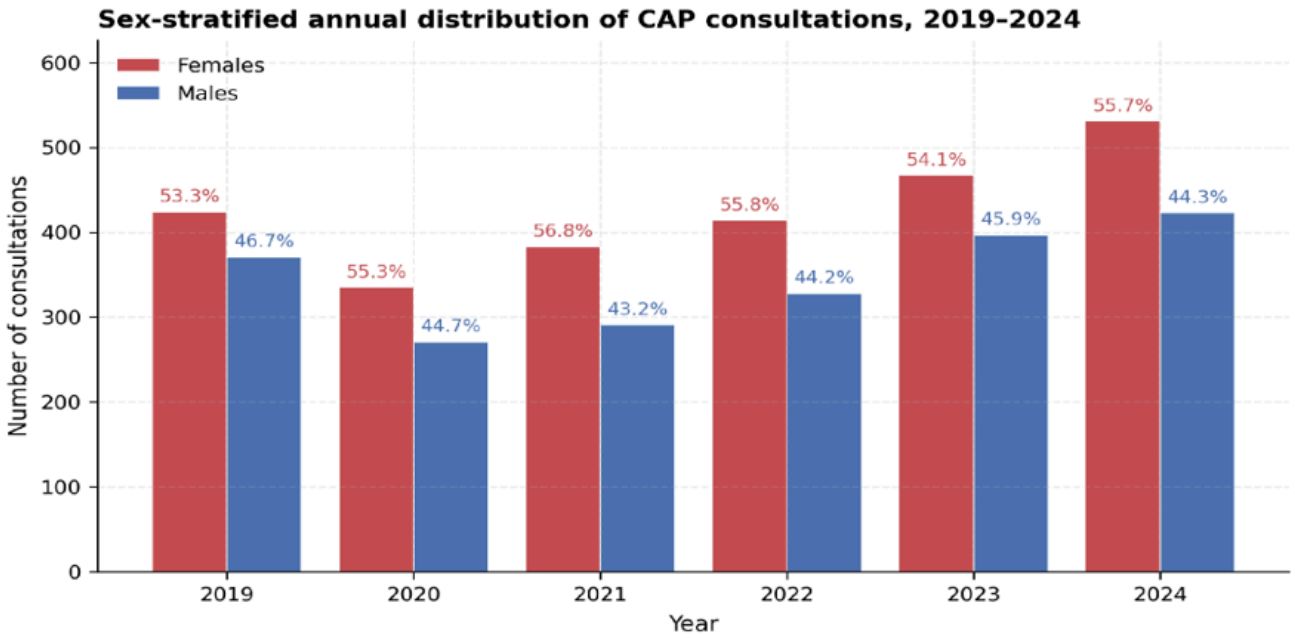


Figure 2

Sex-stratified annual distribution of CAP consultations. Percentages above each bar indicate the within-year share of each sex.

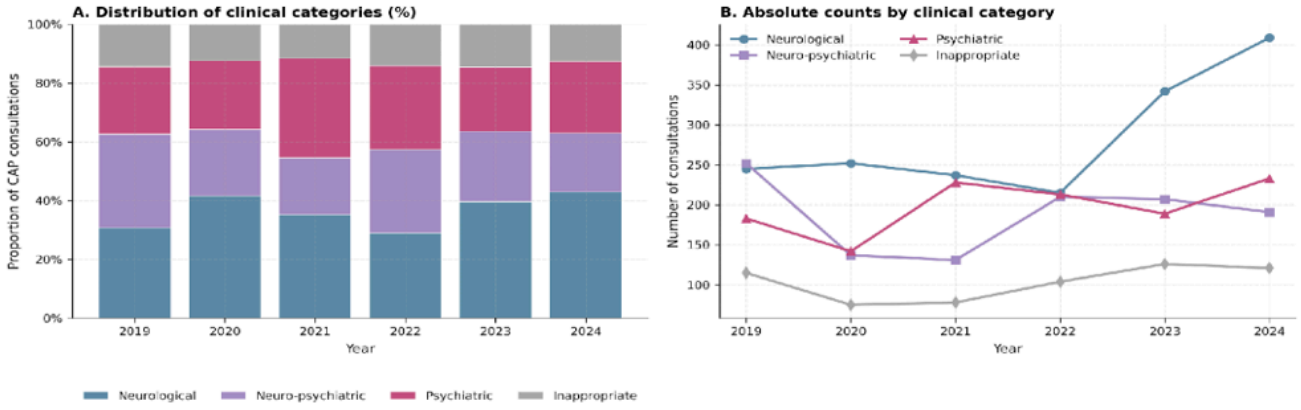


Figure 3

Distribution of CAP consultations by clinical macro-category, 2019–2024. (A) Proportional stacked bar chart; (B) absolute counts. The psychiatric peak in 2021 and the neurological resurgence in 2023–2024 are clearly visible.

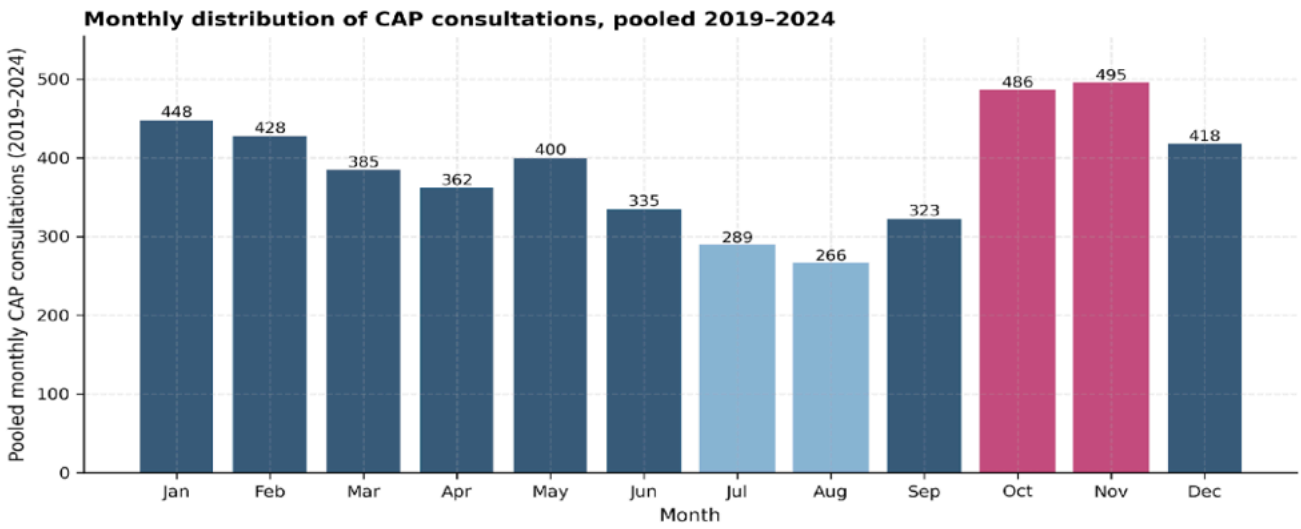


Figure 4

Monthly distribution of CAP consultations pooled across 2019–2024. Summer months are highlighted in light blue and the autumn peak in pink to ease visual reading.

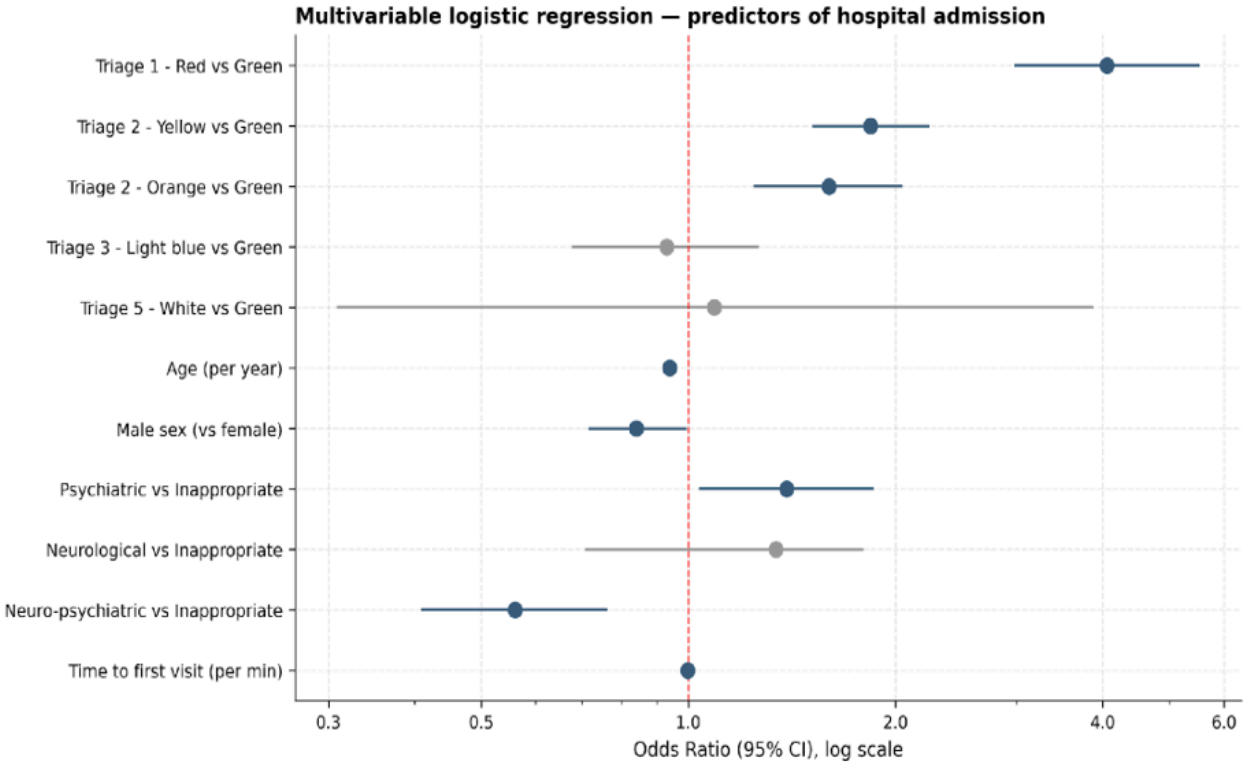


Figure 5

Forest plot of adjusted odds ratios (95% CI, log scale) for hospital admission from the multivariable logistic regression model. Blue markers indicate associations with 95% CI not crossing 1.0; grey markers indicate non-significant predictors. Reference categories: triage green, female sex, inappropriate clinical macro-category.

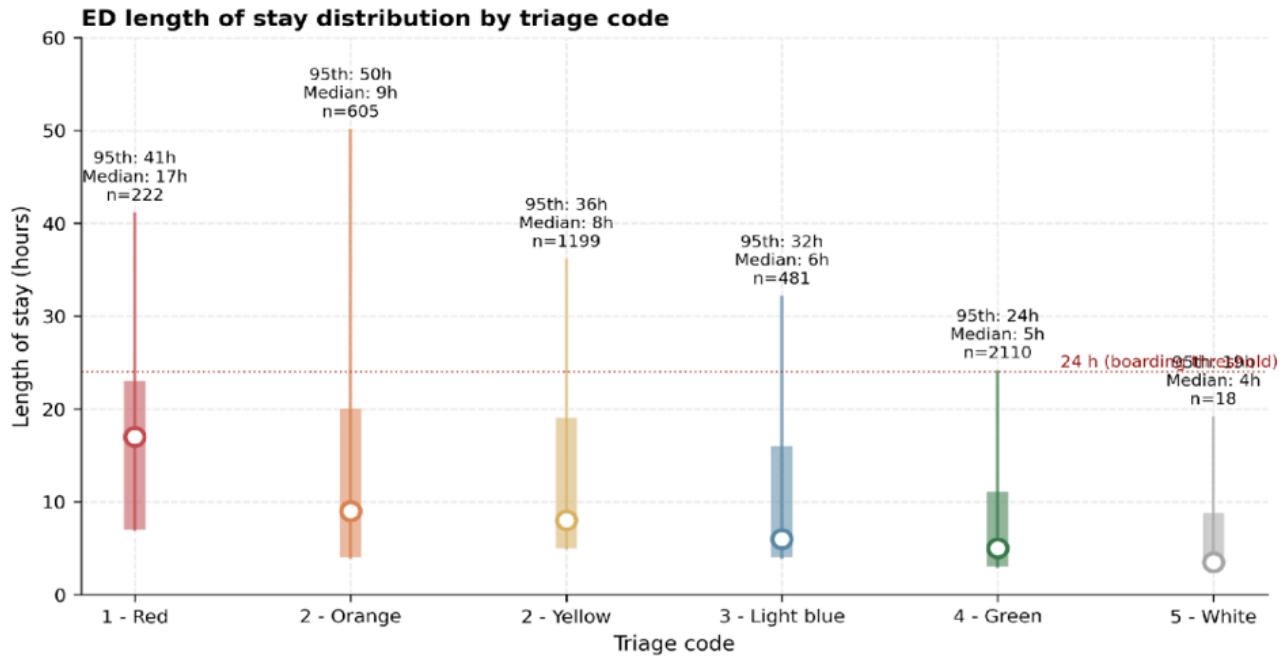


Figure 6

Distribution of ED length of stay by triage code. White circles indicate the median; coloured bars represent the interquartile range; thin vertical lines extend to the 95th centile. The 24-hour boarding threshold is indicated by a dashed red line.

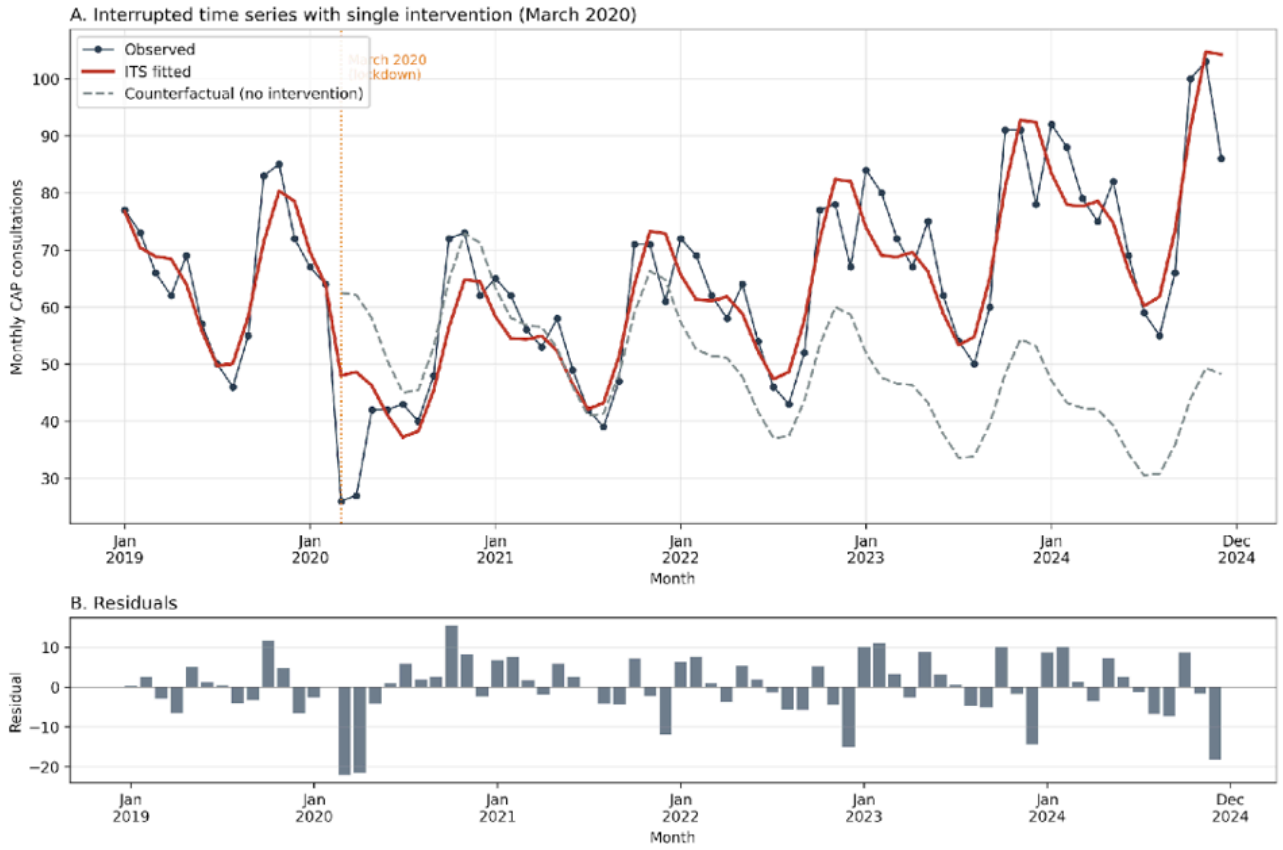


Figure 7

Interrupted time-series analysis. (A) Observed monthly CAP consultations (dark line with dots), ITS fitted values (red), and counterfactual trajectory without intervention (grey dashed). The orange dotted vertical line marks March 2020 (T1). (B) Residuals (observed − fitted) showing the most pronounced negative residuals in March–April 2020 and a roughly homoscedastic pattern thereafter.