ORIGINAL RESEARCH

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Institution-level Emergency Department Care Processes and Flow Metrics from Hospital Information Systems: A Retrospective Descriptive Study

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Abstract

Objective: Full-year, reproducible operational profiles derived from hospital information systems are rarely reported. This study aimed to describe a 2025 institution-level emergency department operational profile derived from a hospital information management system.

Materials and Methods: We performed a retrospective, descriptive, single-center analysis of aggregated, de-identified outputs for all presentations to adult/general, pediatric, and obstetric/gynecology emergency units between January 1 and December 31, 2025. Indicators included visit volume and triage category; laboratory testing, imaging, and consultation activity; mean triage-to-first-physician waiting time by shift; observation unit length-of-stay categories; quarterly 24-hour revisits with the same diagnosis; and the 50 most frequently assigned International Classification of Diseases, 10th Revision diagnosis codes, grouped by chapter.

Results: There were 1,421,126 presentations; the triage distribution was 68.9% green, 28.3% yellow, 2.8% red, and 0.006% black. Resource use increased with acuity (laboratory testing: 9.7%, 21.5%, and 58.0%; any imaging: 13.7%, 39.0%, and 78.3% for green, yellow, and red triage, respectively). The mean triage-to-first-physician waiting time was 12.0 minutes overall and 5.5 minutes overnight (00:00–08:00). Observation stays totaled 268,847, of which 89.8% lasted 0–2 hours. The 24-hour revisit rate was 1.44%, increasing from 1.09% (January–March) to 1.62% (October–December).

Conclusion: Aggregated hospital system outputs can support a reproducible operational dashboard describing demand, acuity-stratified care processes, flow, early returns, and diagnostic mix for monitoring and benchmarking.

Keywords: Crowding, emergency service, health services research, hospital information systems, triage

Introduction

Emergency departments (EDs) sit at the fault line between community demand and hospital capacity and therefore function as a sensitive barometer of health-system performance. Beyond crowding alone, ED operational performance is increasingly evaluated through indicator sets that capture demand, acuity, resource use, and patient flow across the care pathway [1]. ED crowding, prolonged waiting, and delays in downstream flow are widely recognized threats to timely assessment and safe care [1]. Contemporary studies consistently link prolonged ED exposure to clinically meaningful harms, particularly in older or medically vulnerable populations. For example, waiting overnight in the ED prior to ward admission has been associated with increased in-hospital mortality and morbidity among older adults [2]. Similar concerns extend to system-level flow and access: crowding metrics based on occupancy and workload have been investigated as predictors of short-term mortality, with findings varying by setting and measurement approach [3,4]. Waiting time to first physician assessment remains a core operational metric because it reflects both access and triage effectiveness, and large registry-based analyses show that waiting time can also differ systematically across patient subgroups even after accounting for acuity and ED context [5]. In parallel, observation care has expanded as a strategy to manage uncertainty and reduce unnecessary admissions, and recent studies have evaluated both traditional and novel observation models for their effects on ED length of stay and return visits [6,7].

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Despite this growing evidence base, important gaps limit translation into actionable, locally relevant quality improvement. First, the observed associations between crowding-related measures and mortality are not uniform across studies, underscoring context sensitivity and heterogeneity in operational definitions [3,4]. Second, much of the published literature focuses on single outcomes or narrowly defined cohorts rather than on a consolidated indicator set that simultaneously describes case mix (e.g., triage distribution), diagnostic intensity (laboratory and imaging use), patient flow (waiting time and observation unit length of stay), and post-discharge quality signals (early return visits) [1,8,9]. Third, ED dashboards and performance indicator frameworks based on routinely collected data have been described, but their implementation characteristics, indicator selection, and reproducible reporting logic are inconsistently reported across settings [10,11]. Fourth, routine hospital information management systems, when used to generate aggregated and reproducible institutional dashboards, remain underdescribed in the peer-reviewed literature, particularly across multiple ED streams such as adult/general, pediatric, and obstetric/gynecology emergency services within the same institution. These limitations impede benchmarking, obscure where delays accumulate along the ED pathway, and reduce the transparency needed for other centers to replicate indicator-based monitoring.

In Türkiye, high ED utilization and the predominance of lower-acuity presentations are frequently discussed in clinical and policy contexts, but full-year empirical profiles that integrate triage distribution, diagnostic resource use, waiting time, observation unit flow, early revisits, and diagnostic mix within the same institutional framework remain limited. Routine HIMS data can help address this gap when indicator definitions, denominators, and system-related constraints are reported transparently. Therefore, the contribution of this study is not to provide patient-level causal or prognostic inference but to demonstrate a reproducible institution-level operational profiling framework for ED monitoring and benchmarking.

Accordingly, the aim of this study was to describe a full-year, institution-level profile of ED service delivery indicators derived from routine Hospital Information Management System (HIMS) outputs from January 1, 2025, to December 31, 2025. To support monitoring and benchmarking, we summarized key operational domains, including demand and acuity distribution, care processes and resource use, patient flow metrics, observation unit utilization, early return visits, and diagnostic mix, within a reproducible, aggregated reporting framework. We reported ED volume and triage distribution, key process indicators (laboratory testing, imaging and modality components, prescriptions, consultations, observation unit use, hospital admission, and interhospital transfer), mean triage-to-physician waiting time by shift, observation unit length-of-stay categories, quarterly 24-hour return-visit rates, and the most frequent ICD-10 code assignments aggregated by ICD-10 chapter.

Materials and Methods

Study Design and Setting

We performed a retrospective, descriptive, single-center analysis of institutional ED service indicators generated by the HIMS at a large tertiary training and research hospital in eastern Türkiye. The study hospital functions as an A1-role regional referral institution with 1,500 registered beds and serves both the province of Van and the wider second health service region, including Van, Hakkari, Muş, Bitlis, and selected districts of Ağrı. Emergency care is organized through three operationally distinct service lines: adult/general emergency, pediatric emergency, and obstetric/gynecology emergency. These service lines are recorded separately in the HIMS reporting structure but function within the same institutional emergency care framework. Therefore, the annual ED volume reported in this study reflects the combined emergency workload of these three service streams rather than the volume of a single adult-only emergency department.

We set the observation window from January 1, 2025, through December 31, 2025, and included aggregated outputs from these three ED service lines. We treated the ED encounter as the unit of analysis, as represented in HIMS reporting outputs, rather than an identifiable individual. We analyzed only aggregated, de-identified institutional indicators produced as routine operational reports and did not access, extract, or link any individual-level patient records. All analyses were conducted at the institutional indicator level; therefore, the findings are interpreted as service profiling rather than patient-level inference.

Ethics Statement

This study was approved by the Non-Interventional Clinical Research Ethics Committee of SBU Van Education and Research Hospital on February 6, 2026 (approval number: GOKAEK/2026-02-24). We conducted the study in accordance with applicable national regulations and the principles of the Declaration of Helsinki.

Participants/Subjects

We included all ED presentations recorded in the HIMS within the predefined time window for the adult/general, pediatric, and obstetric/gynecology emergency units. We applied no patient-level inclusion or exclusion criteria because the HIMS extracts were limited to aggregated institutional indicators and did not contain individual identifiers or person-level covariates. We did not characterize the population by age, sex, comorbidities, or other individual clinical variables because such data were not available in the aggregated exports. For triage-based analyses, we used the national triage categories recorded in the HIMS (green, yellow, red, and black). We retained black-triage encounters for overall volume reporting but considered them not applicable to analyses in which the underlying construct required waiting for evaluation or downstream care processes (e.g., waiting time), consistent with routine ED workflow definitions. Black triage was operationally treated as "not applicable" for pathway-dependent indicators rather than excluded from overall volume counts.

Materials and Equipment

We used the institution's HIMS reporting module to generate aggregated indicators within the specified date range and service lines and exported these outputs as Microsoft Excel files using built-in institutional reporting functions. We processed, checked, and analyzed the exported datasets using Microsoft Excel and Python (version 3.13; Python Software Foundation, Wilmington, DE, USA). We generated tables and figures using Python with standard scientific libraries (e.g., pandas, NumPy, SciPy, and Matplotlib) and performed spreadsheet-based verification in Excel. No medical devices, drugs, or laboratory instruments were used for research purposes because the study relied exclusively on routinely produced institutional indicators. Figures were created as editable vector outputs (e.g., PDF) to comply with journal requirements for modifiable figure files.

Study Procedures

We prespecified the indicator set, time window, and stratification scheme before extraction. We first generated annual totals for ED volume and triage distribution by service line (adult/general, pediatric, and obstetric/gynecology). We then extracted triage-stratified process indicators generated by the HIMS as aggregated operational counts. For each triage category, the denominator was the number of ED presentations in that category. Laboratory testing was interpreted as a presentation-associated indicator representing ED presentations for which at least one laboratory request was recorded in the HIMS. Any imaging was interpreted as a presentation-associated indicator representing ED presentations with at least one imaging request, whereas modality-specific imaging components, including radiography, ultrasonography, computed tomography, and magnetic resonance imaging, were interpreted as HIMS-derived imaging request indicators summarized by triage category. Because the exported data were aggregated operational reports rather than patient-level linked records, these indicators should not be interpreted as unique patient-level utilization measures, and repeated or multiple requests within the same encounter could not be separately evaluated. We also extracted aggregated counts of presentations with a prescription issued and presentations with at least one specialty consultation requested, as defined by the HIMS operational reporting logic.

We extracted aggregated counts for hospital admission and interhospital transfer as generated by the HIMS. Because institutional HIMS workflow rules system-disabled admission and transfer transactions for green-triage encounters, green-triage values for these endpoints were treated as structural zeros driven by system rules rather than as clinically observed absences of admissions or transfers. To avoid misinterpretation in reporting, green-triage values for admission and transfer were presented as NA (structural zero) rather than 0%.

We defined waiting time as the mean time, in minutes, from triage registration to first physician assessment, as recorded in the HIMS. We extracted HIMS-reported mean waiting times separately for three shifts (08:00–16:00, 16:00–00:00, and 00:00–08:00) and obtained, for each shift and triage category, the number of visits contributing to the reported mean. We did not attempt to reconstruct waiting-time distributions because the HIMS outputs provided aggregated means without dispersion measures. Accordingly, waiting-time comparisons were restricted to descriptive contrasts of the reported means.

We defined ED observation unit length of stay as the elapsed time between admission to an ED observation bed and discharge from the observation unit or conversion to hospital admission, based on routine HIMS timestamps. We used the HIMS quality-monitoring categorization of observation length of stay into four bins (0–2 hours, 3–8 hours, 9–24 hours, and ≥24 hours) and extracted both annual totals and month-by-month distributions for these categories. We additionally defined "prolonged observation" as a length of stay ≥9 hours (9–24 hours plus ≥24 hours) for summary reporting.

We evaluated early return visits using the institution's HIMS-linked quality indicator for return ED presentations within 24 hours with the same diagnosis. This indicator was generated by the HIMS quality-monitoring module according to the institutional diagnosis-matching rule and predefined eligibility-denominator framework. Same-diagnosis matching was based on the diagnosis information recorded in the HIMS for the index and return ED presentations, as operationalized by the institutional quality indicator specification. The 24-hour interval was calculated from the registration time of the index ED presentation to the registration time of the return

ED presentation. We extracted quarterly and annual numerator and denominator values for 2025, with quarters prespecified as January–March, April–June, July–September, and October–December. Because the indicator used a denominator defined by institutional reporting rules and exclusions for quality monitoring, we treated its denominator as indicator-specific and did not assume equivalence to overall ED visit counts derived from other HIMS extracts. Accordingly, the return-visit indicator was interpreted within its own eligibility-denominator framework rather than as a crude proportion of total ED presentations. We also reported a Q4-versus-Q1 contrast (risk ratio and absolute difference) as an interpretable summary of temporal change.

For diagnostic profiling, we extracted aggregated counts of ICD-10 diagnosis code assignments and identified the 50 most frequently assigned codes within the study period. Because aggregated ICD-10 outputs represented code assignments rather than unique patients, and because encounters could receive more than one ICD-10 code, we interpreted these data as assignment frequencies. We grouped the top 50 codes into ICD-10 chapters and summarized the distribution at the chapter level for descriptive reporting. To summarize diagnostic-mix concentration and diversity, we computed the Herfindahl–Hirschman Index and Shannon entropy from the chapter-level distribution and derived the effective number of chapters as exp(entropy).

Data Processing and Quality Assurance

We cross-checked HIMS exports with the hospital quality management unit to ensure internal consistency with routine institutional reporting. We verified concordance between overall annual totals and the sums across triage categories and service lines when both were available and assessed the completeness and plausibility of monthly and quarterly subtotals (observation unit length-of-stay distributions and the 24-hour return-visit indicator). We maintained a fixed extraction schema (variable names, stratification levels, and time windows) across datasets to support traceability and reproducibility of the aggregated workflow. We additionally screened exported tables for formatting anomalies (e.g., truncated or locale-formatted numeric strings) and flagged such fields for source-level verification prior to final submission. All derived measures (risk ratios, absolute differences, and indices) were computed reproducibly from the exported aggregates using scripted analysis.

Statistical Analysis

We summarized aggregated indicators using counts and percentages for categorical measures and HIMS-reported means for waiting time. For key proportions, we reported binomial Wilson 95% confidence intervals using the extracted n/N pairs. Between-triage contrasts for process indicators were expressed as absolute percentage-point differences (RD, percentage points) and relative risks (RRs), with 95% confidence intervals computed on the log scale from aggregated counts. Given the very large denominators, we prioritized effect sizes and confidence intervals over p values to reduce overinterpretation of statistical significance driven by sample size.

As an additional operational analysis, we calculated the contribution of each triage category to the aggregate diagnostic and process workload. For each selected indicator, the number of HIMS-derived indicator events in each triage category was divided by the total number of corresponding indicator events across triage categories. This analysis was intended to distinguish within-category utilization rates from each triage category's contribution to the total institutional workload.

For the 24-hour return-visit quality indicator, we computed quarterly and annual rates with Wilson 95% confidence intervals. We evaluated temporal change across quarters using binomial logistic regression with a logit link, with quarter entered as a linear term, and reported an odds ratio (OR) per quarter with a 95% confidence interval and a two-sided p value. This model used only the aggregated numerator/denominator pairs and was interpreted as a trend analysis under the institutional indicator definition. In addition, we reported an absolute quarterly contrast (Q4–Q1) and a relative contrast (Q4 vs. Q1) derived from the quarterly aggregates.

We evaluated differences in mean waiting times across shifts and triage categories descriptively without formal hypothesis testing because the HIMS provided aggregated means without accompanying measures of dispersion, precluding standard inferential comparisons of means. We did not perform an a priori sample size or power calculation because the study used a census of all eligible aggregated ED encounters and institutional indicators within a fixed annual time window, and the analytic sample size was determined by the operational volume captured in the HIMS exports. We conducted statistical analyses using Python 3.13 and produced tabular and graphical outputs using Python and Microsoft Excel.

Reporting Guideline

We prepared the manuscript in accordance with the STROBE principles for observational research, with adaptations appropriate to an aggregated, institution-level indicator design without access to individual-level variables. Given the use of routinely collected institutional indicators, we also applied RECORD-aligned principles where applicable, including data provenance, indicator definitions, and traceability of aggregated denominators.

Results

Study Population and Data Inclusion

A total of 1,421,126 emergency department presentations were recorded across adult/general, pediatric, and obstetric/gynecology service lines during the study period (Table 1). Green-triage encounters accounted for 978,848 presentations (68.9%), followed by yellow-triage encounters with 402,859 presentations (28.3%) and red-triage encounters with 39,328 presentations (2.8%). Black-triage encounters were rare, with 91 presentations (0.006%). Black-triage encounters were retained for overall volume reporting but excluded from analyses in which waiting time or downstream care pathways were not applicable (Table 1). Uncertainty for key proportions was summarized using 95% confidence intervals (Tables 2 and 3).

ED Workload by Service Line and Triage Acuity

Case mix differed by service line. Pediatric ED presentations were predominantly green triage, with 331,846 of 400,349 presentations (82.9%) categorized as green. Obstetric/gynecology ED presentations were predominantly yellow triage, with 25,127 of 30,419 presentations (82.6%) categorized as yellow. The adult/general ED accounted for the largest overall workload and the majority of higher-acuity encounters, including 37,585 of 39,328 red-triage presentations (95.6%) (Table 1).

Care Processes by Triage Category

Care intensity increased stepwise with triage acuity across laboratory testing and imaging. Laboratory testing was recorded in 95,343 green-triage presentations (9.7%), 86,560 yellow-triage presentations (21.5%), and 22,799 red-triage presentations (58.0%). Any imaging was recorded in 134,038 green-triage presentations (13.7%), 157,282 yellow-triage presentations (39.0%), and 30,773 red-triage presentations (78.3%). CT use increased from 10,543 green-triage presentations (1.1%) to 33,076 yellow-triage presentations (8.2%) and 9,534 red-triage presentations (24.2%) (Table 2).

Although green-triage presentations had the lowest within-category rates of laboratory testing and imaging, their high volume meant that they contributed substantially to the aggregate diagnostic and process workload. Based on the counts shown in Table 2, green-triage presentations accounted for approximately 46.6% of all laboratory-testing indicators and 41.6% of all imaging indicators. They also accounted for approximately 73.1% of prescription-associated presentations. In contrast, consultation workload was concentrated mainly in the yellow- and red-triage categories, with green-triage presentations accounting for only approximately 1.1% of consultation indicators.

Consultation and admission indicators demonstrated the largest acuity gradients. Specialty consultation was recorded in 0.03% of green-triage presentations, 4.47% of yellow-triage presentations, and 22.01% of red-triage presentations. Hospital admission was recorded in 24,405 yellow-triage presentations (6.06%) and 7,136 red-triage presentations (18.14%). Admission and interhospital transfer workflows were system-disabled for green-triage encounters and were therefore reported as structural zeros rather than as an observed clinical absence of admission or transfer (Table 2). Prescribing showed the opposite pattern, decreasing from 40.65% in green-triage presentations to 34.22% in yellow-triage presentations and 21.36% in red-triage presentations (Table 2).

Time-to-Physician Assessment (Waiting Time)

The mean triage-to-first-physician waiting time was 12.0 minutes overall. The overnight shift had the shortest overall mean waiting time, at 5.5 minutes, compared with 12.8 minutes during 08:00–16:00 and 12.5 minutes during 16:00–00:00. Waiting time also decreased with increasing triage acuity. The overall mean waiting time was 13.9 minutes for green-triage presentations, 8.1 minutes for yellow-triage presentations, and 4.0 minutes for red-triage presentations (Table 4).

Observation Unit Length of Stay

Observation unit stays were predominantly short. Of 268,847 observation stays, 241,323 (89.8%) lasted 0–2 hours, and 27,257 (10.1%) lasted 3–8 hours. Prolonged observation, defined as an observation unit length of stay of ≥9 hours, was rare and occurred

Table 1. Emergency department presentations and triage distribution by service line (2025)

Service line	Total	Green	Yellow	Red	Black
Pediatric ED	400349	331846 (82.9)	66791 (16.7)	1709 (0.43)	3 (0.001)
Obstetrics/Gynecology ED	30419	5257 (17.3)	25127 (82.6)	34 (0.11)	1 (0.003)
Adult/General ED	990358	641745 (64.8)	310941 (31.4)	37585 (3.8)	87 (0.009)
Overall	1421126	978848 (68.9)	402859 (28.3)	39328 (2.8)	91 (0.006)

Values are n (%). Percentages are row-wise within each service line and may not sum to 100 due to rounding. Black indicates deceased on arrival/exit (Ex). ED: Emergency department.

Table 2. Care processes by triage category and effect measures (2025)

Indicator	Green (n=978,848)	Yellow (n=402,859)	Red (n=39,328)	Yellow vs Green RR (95% CI)	Yellow vs Green RD, pp (95% CI)	Red vs Yellow RR (95% CI)	Red vs Yellow RD, pp (95% CI)
≥1 laboratory test	95,343 (9.74; 9.68–9.80)	86,560 (21.49; 21.36–21.61)	22,799 (57.97; 57.48–58.46)	2.206 (2.187–2.225)	+11.746 (+11.606 to +11.886)	2.698 (2.670–2.726)	+36.485 (+35.981 to +36.989)
Any imaging	134,038 (13.69; 13.63–13.76)	157,282 (39.04; 38.89–39.19)	30,773 (78.25; 77.84–78.65)	2.851 (2.833–2.869)	+25.348 (+25.183 to +25.513)	2.004 (1.991–2.017)	+39.206 (+38.771 to +39.640)
Radiography	116,334 (11.88; 11.82–11.95)	110,463 (27.42; 27.28–27.56)	18,118 (46.07; 45.58–46.56)	2.307 (2.290–2.324)	+15.535 (+15.383 to +15.687)	1.680 (1.660–1.700)	+18.649 (+18.138 to +19.161)
CT	10,543 (1.08; 1.06–1.10)	33,076 (8.21; 8.13–8.30)	9,534 (24.24; 23.82–24.67)	7.623 (7.460–7.789)	+7.133 (+7.046 to +7.220)	2.953 (2.893–3.013)	+16.032 (+15.600 to +16.464)
Ultrasound	6,203 (0.63; 0.62–0.65)	11,586 (2.88; 2.82–2.93)	934 (2.37; 2.23–2.53)	4.538 (4.401–4.679)	+2.242 (+2.188 to +2.296)	0.826 (0.773–0.882)	−0.501 (−0.660 to −0.342)
MRI	958 (0.10; 0.09–0.10)	2,157 (0.54; 0.51–0.56)	2,187 (5.56; 5.34–5.79)	5.471 (5.070–5.903)	+0.438 (+0.414 to +0.461)	10.386 (9.795–11.013)	+5.026 (+4.798 to +5.253)
Prescription	397,868 (40.65; 40.55–40.74)	137,845 (34.22; 34.07–34.36)	8,401 (21.36; 20.96–21.77)	0.842 (0.838–0.846)	−6.430 (−6.606 to −6.254)	0.624 (0.612–0.637)	−12.855 (−13.286 to −12.425)
Consultation	306 (0.03; 0.03–0.03)	18,001 (4.47; 4.40–4.53)	8,658 (22.01; 21.61–22.43)	142.935 (127.671–160.024)	+4.437 (+4.373 to +4.501)	4.927 (4.813–5.044)	+17.547 (+17.132 to +17.961)
Hospital admission*	NA (structural zero)	24,405 (6.06; 5.98–6.13)	7,136 (18.14; 17.77–18.53)	NA	NA	2.995 (2.923–3.069)	+12.087 (+11.699 to +12.475)
Inter-hospital transfer*	NA (structural zero)	176 (0.04; 0.04–0.05)	84 (0.21; 0.17–0.26)	NA	NA	4.889 (3.771–6.339)	+0.170 (+0.124 to +0.216)

Values are n (%), with percentages calculated within triage category unless otherwise stated. Confidence intervals for proportions are Wilson 95% confidence intervals. Laboratory testing and any imaging represent presentation-associated HIMS indicators, whereas modality-specific imaging variables represent HIMS-derived request indicators summarized by triage category. Because the exported data were aggregated operational reports rather than patient-level linked records, repeated or multiple requests within the same encounter could not be separately evaluated. RR indicates risk ratio; RD indicates absolute risk difference in percentage points (pp); CI indicates confidence interval; NA indicates not applicable due to structural zero. Effect measures are presented for the comparisons shown in the column headers (yellow vs green; red vs yellow). Hospital admission and inter-hospital transfer workflows were system-disabled for green-triage encounters (structural zeros) and are therefore reported as NA.

in 267 stays (0.10%; Wilson 95% CI, 0.09–0.11). Only 61 stays (0.02%) lasted ≥24 hours (Table 5).

Return Visits Within 24 Hours With the Same Diagnosis

The annual 24-hour same-diagnosis revisit rate was 1.44% (20,457/1,421,126). The quarterly rate increased from 1.09% in January–March to 1.44% in April–June, 1.59% in July–September, and 1.62% in October–December. The binomial logit trend estimate showed an increase across quarters (OR per quarter=1.130, 95% CI, 1.116–1.144; p<0.001). The Q4-versus-Q1 contrast corresponded to a risk ratio of 1.488 (95% CI, 1.429–1.551) and an absolute difference of +0.533 percentage points (95% CI, +0.479 to +0.587) (Table 3).

Table 3. 24-hour revisits with the same diagnosis (quality indicator), by quarter (2025)

Period (2025)	Numerator/ Denominator	Rate (%)	95% CI (Wilson)
January–March	3,666 / 335,919	1.091	1.057–1.127
April–June	5,397 / 375,677	1.437	1.399–1.475
July–September	5,555 / 350,063	1.587	1.546–1.629
October–December	5,839 / 359,467	1.624	1.584–1.666
Overall	**20,457 / 1,421,126**	**1.439**	**1.420–1.459**
Trend (binomial logit; per quarter)	—	OR = 1.130	95% CI 1.116–1.144; p < 0.001
Additional contrast: Q4 vs Q1	—	RR = 1.488	95% CI 1.429–1.551
Additional contrast: Q4 – Q1	—	RD = +0.533 pp	95% CI +0.479 to +0.587

OR: Odds ratio; RR: Risk ratio; RD: absolute risk difference (percentage points, pp); CI: Confidence interval; Q1: January–March; Q4: October–December.

Diagnostic Profile (ICD-10 Chapter Aggregation of Top 50 Codes)

The top 50 ICD-10 diagnosis code assignments showed a diagnostic profile dominated by respiratory diseases and symptom-based

Table 4. Mean triage-to-first-physician waiting time (minutes) by triage category and shift (2025)				
Triage	**08:00–16:00 mean (n)**	**16:00–00:00 mean (n)**	**00:00–08:00 mean (n)**	**Overall mean (n)**
Red	4.13 (13471)	4.56 (14638)	3.09 (11219)	3.99 (39328)
Yellow	8.77 (185147)	8.07 (185064)	4.37 (32648)	8.09 (402859)
Green	14.69 (438859)	14.56 (454697)	6.21 (85292)	13.89 (978848)
Overall	12.75 (637477)	12.50 (654399)	5.48 (129159)	11.97 (1421035)

Table 5. Observation unit length-of-stay categories (2025)		
Length of stay category	**n**	**%**
0–2 hours	241,323	89.76
3–8 hours	27,257	10.14
9–24 hours	206	0.08
≥24 hours	61	0.02
Prolonged observation (≥9 hours)	267	0.10 (Wilson 95% CI 0.09–0.11)
Total	268,847	100

Prolonged observation was defined as length of stay ≥9 hours; the percentage is reported with a Wilson 95% confidence interval.

presentations. Respiratory diseases accounted for 585,142 code assignments (41.7%) among the top 50 diagnoses, followed by symptoms and signs with 260,469 assignments (18.5%) and musculoskeletal disorders with 142,790 assignments (10.2%). The diagnostic-mix indices indicated moderate concentration, with a Herfindahl–Hirschman Index of 0.232, Shannon entropy of 1.844, and an effective number of chapters of 6.33 (Table 6).

Discussion

This retrospective, aggregated indicator study described a full-year institutional profile of emergency department service delivery across adult/general, pediatric, and obstetric/gynecology emergency streams. This study adds to the emergency care literature by showing how routinely generated HIMS indicators can be assembled into a full-year operational profile of a high-volume ED system. Rather than examining a single outcome, the analysis brings together demand, triage acuity, diagnostic workload, waiting time, observation unit flow, early revisit signals, and diagnostic mix within the same institutional year. In a setting where high ED utilization and lower-acuity demand are frequently discussed but comprehensive full-year empirical profiles remain limited, this reporting approach provides a data-based baseline for local monitoring and future benchmarking. Overall, the ED workload was dominated by lower-acuity presentations, accompanied by an internally coherent "acuity gradient" in diagnostic intensity and escalation pathways, shift-dependent variation in time to first physician assessment, predominantly short observation unit stays, a low but nonzero early return-visit signal that varied by quarter, and a diagnostic profile dominated

Table 6. Distribution of top 50 ICD-10 code assignments by ICD-10 chapter		
ICD-10 chapter	**n***	**% of code assignments among top-50 diagnoses**
Respiratory diseases (J00–J99)	585,142	41.7
Symptoms and signs (R00–R99)	260,469	18.5
Musculoskeletal disorders (M00–M99)	142,790	10.2
Factors influencing health status / encounters (Z00–Z99)	98,986	7
Infectious and parasitic diseases (A00–B99)	74,396	5.3
External causes of morbidity and mortality (V01–Y98)	62,429	4.4
Digestive diseases (K00–K93)	61,974	4.4
Genitourinary diseases (N00–N99)	48,711	3.5
Eye and ear diseases (H00–H95)	31,788	2.3
Injury, poisoning and other consequences of external causes (S00–T98)	26,208	1.9
Skin and subcutaneous tissue diseases (L00–L99)	11,539	0.8
Diagnostic-mix indices (chapter distribution)		
Herfindahl–Hirschman Index (HHI)	—	0.232
Shannon entropy	—	1.844
Effective number of chapters (exp[entropy])	—	6.33

Values represent counts of ICD-10 code assignments among the 50 most frequently assigned diagnosis codes; percentages are calculated as the proportion of all top 50 code assignments. n indicates the number of code assignments (not unique patients or visits). Diagnostic-mix indices (Herfindahl–Hirschman Index and Shannon entropy) were calculated from the chapter-level distribution of top 50 code assignments shown in this table; the effective number of chapters was computed as exp(entropy).

by respiratory and symptom-based codes in our institutional data [9]. Framed against evidence-based quality measurement frameworks, these findings provide a reproducible baseline for local benchmarking and for prioritizing operational domains for iterative monitoring rather than implying causal effects or patient-level outcomes [12]. In particular, the explicit specification of indicator definitions and system rules strengthens interpretability and supports cross-time comparability.

A central operational implication of the observed case mix is that high-volume, low-acuity demand can still generate substantial resource use and throughput pressure [1]. Prior multisite analyses show that "nonurgent" ED visits often require laboratory and imaging resources and therefore cannot be assumed to be operationally trivial. In our institution-level profile, green-triage presentations had the lowest within-category rates of laboratory testing and imaging, but they accounted for approximately 46.6% of all laboratory-testing indicators, 41.6% of all imaging indicators, and 73.1% of prescription-associated presentations because of their large volume. Therefore, interpreting ED workload only through triage-specific percentages would underestimate the contribution of high-volume, lower-acuity care. In practical terms, workload is shaped not only by acuity but also by how frequently each group uses diagnostic and prescribing resources. Accordingly, demand management and streaming strategies should consider both the clinical acuity of presentations and their aggregate contribution to diagnostic, prescribing, and staffing workload. This also helps contextualize the service-line differences, including the predominance of green-triage presentations in the pediatric ED and yellow-triage presentations in the obstetric/gynecology ED, which likely reflect stream-specific triage rules and referral patterns rather than simple differences in illness severity [13,14].

Across triage strata, process indicators demonstrated a stepwise increase in laboratory testing, imaging, consultation, observation use, and admission among higher-acuity encounters, consistent with the intended function of triage as a prioritization and resource-allocation instrument. External validation studies of widely used triage systems support the association of higher-acuity categories with greater resource utilization and downstream care needs, aligning with the internal face validity of the patterns observed here. At the same time, the interpretation of some downstream indicators in our dataset required attention to the "data-generating process": because admissions and transfers were system-disabled for green-triage encounters, those cells represent structural zeros rather than an observed clinical absence. This is not a minor technicality; it directly affects between-triage comparisons and reinforces the need for explicit indicator metadata, including definitions, system rules, and denominators, as part of institutional dashboards to ensure comparability over time and across centers [12,13]. Without such metadata, apparent between-triage or between-center differences may reflect reporting rules rather than true clinical or operational variation.

The waiting-time profile suggests two complementary operational signals. First, shorter times to first physician assessment among higher-acuity encounters are consistent with effective prioritization. Second, the observed shift-level variation indicates that access to timely assessment is not uniform throughout the day, plausibly reflecting the interaction among arrival patterns, staffing, and competing workflow constraints (e.g., diagnostics and disposition during peak hours). Large population-based studies have reported associations between longer ED waiting times and adverse downstream outcomes, including short-term mortality and hospital admission, underscoring why time to provider remains a core access and safety proxy even when patient-level outcomes are not directly measured in a given dataset [15]. In parallel, patient-reported experience has been shown to worsen as waiting times increase in both admitted and discharged cohorts, supporting the relevance of this metric for quality governance beyond clinical endpoints alone [16]. These findings support the use of waiting time as a practical monitoring metric for staffing alignment and surge-response planning, while recognizing that aggregate means cannot identify the longest waits [15,16].

Observation unit utilization in this profile was characterized by predominantly short stays, with a very small proportion of prolonged observation periods. This pattern is broadly consistent with the conceptual role of ED observation care as a time-limited diagnostic and treatment strategy to manage uncertainty, reduce unnecessary inpatient admissions, and maintain flow when protocolized pathways are available. In our institution, the predominance of 0–2-hour observation stays may suggest that the observation unit functioned primarily as a short-term reassessment, treatment, and disposition-decision area rather than as a prolonged boarding space. Possible systemic explanations include rapid discharge after short-term treatment or reassessment, early conversion to inpatient admission when needed, and local workflow rules for opening and closing observation records. The available aggregate data did not include patient-level observation indications, diagnoses linked to observation stays, treatment details, or disposition after observation; therefore, these explanations remain interpretive rather than causal. Although we did not evaluate condition-specific observation pathways, the short-stay distribution observed here is consistent with a time-limited observation model at the institutional level. In our data, the rarity of prolonged observation stays may indicate effective conversion to admission or discharge decisions within expected time windows, but it may also mask clinically relevant congestion episodes if prolonged stays cluster within short periods. Therefore, future monitoring may benefit from complementing categorical LOS bins with time-series dashboards, such as weekly or shift-level monitoring, to detect episodic access block [17–19].

The ICD-10 chapter distribution provides an additional operational perspective on ED demand. The predominance of respiratory diseases among the top 50 diagnosis code assignments suggests a substantial burden of acute respiratory and seasonal infectious presentations within the institutional ED workload. The high proportion of symptom- and sign-based codes is also clinically plausible in the emergency care context, where initial assessment often focuses on syndromic presentation, rule-out evaluation, and short-term management before a definitive outpatient or inpatient diagnosis is established. Musculoskeletal disorders, digestive diseases, genitourinary diseases, and external-cause-related codes further indicate that the ED case mix extends beyond high-acuity resuscitation and includes a broad range of ambulatory, diagnostic, and injury-related presentations. From an operational perspective, this diagnostic profile can inform staffing, fast-track design, respiratory-season preparedness, imaging and laboratory planning, and coding-quality monitoring. However, because these data represent ICD-10 code assignments among the top 50 diagnoses rather than unique patients or adjudicated final diagnoses, they should be interpreted as an operational diagnostic profile rather than as epidemiological disease incidence.

The early return-visit indicator (return within 24 hours with the same diagnosis under institutional rules) provides a quality signal that warrants cautious interpretation. Prior national and single-center studies emphasize that short-interval returns are heterogeneous, driven by disease progression, discharge decisions under uncertainty, access to follow-up care, and patient behavior, and may not function as a specific safety indicator when used in isolation [8]. However, because definitions and time windows differ across studies (e.g., 24 hours vs. longer intervals), comparisons should focus on the concept of short-interval return rather than assume equivalence of indicator specifications. Moreover, return visits resulting in admission have been proposed as a potentially more "actionable" subset, but even these remain an imperfect proxy for preventable harm without clinical review and risk adjustment. In this context, the quarter-to-quarter variation observed in our institutional indicator can reasonably be treated as a trigger for targeted audit (e.g., condition-specific review, shift-level clustering, and linkage to observation/discharge pathways) rather than as a standalone performance judgment [20–22]. For this reason, the 24-hour same-diagnosis revisit rate is best viewed as a routine quality-monitoring signal rather than as evidence of preventable return visits, diagnostic error, or unsafe discharge at the patient level.

This study has several strengths relevant to institutional benchmarking. It used a full-year census of ED presentations across three service lines, applied a prespecified indicator set aligned with evidence-based measurement priorities, and used a reproducible extraction-and-cross-check workflow with the quality management unit, supporting internal traceability [12]. Although the absolute indicator values are institution-specific, the indicator framework and reporting logic are transferable to other centers using routinely collected information-system outputs.

Study Limitations

However, several limitations are intrinsic to the aggregated design. First, the absence of patient-level variables precluded case-mix adjustment and subgroup analyses, including age, sex, comorbidity, arrival mode, and clinical severity, thereby limiting causal interpretation and comparisons with outcome-focused literature. Because the dataset consisted of aggregated institutional HIMS-derived indicators rather than patient-level linked records, patient-level correlational or regression analyses were not methodologically appropriate. Therefore, associations between individual patient characteristics, clinical outcomes, resource use, waiting time, observation duration, and revisit risk could not be evaluated. Second, several indicators were constrained by information-system rules, notably structural zeros for green-triage admission and transfer, which can bias acuity comparisons if not explicitly handled as "not applicable" rather than "none." Third, waiting time was available only as aggregated means without measures of dispersion, preventing inference regarding high-risk distribution tails and formal statistical comparisons between shifts. Fourth, the 24-hour same-diagnosis revisit indicator was generated according to institutional HIMS quality-monitoring rules and was not adjudicated through chart review; therefore, it should not be interpreted as a patient-level preventable revisit outcome. Finally, ICD-10 outputs represented code assignments rather than unique patients and may vary according to coding practices; therefore, chapter-level distributions should be interpreted as an operational diagnostic profile rather than as epidemiological incidence.

Conclusion

This study provided a reproducible, full-year, institution-level profile of emergency department service indicators derived from routine HIMS outputs across adult/general, pediatric, and obstetric/gynecology emergency streams. The findings supported internally coherent acuity gradients in diagnostic and escalation processes and identified shift-dependent access patterns and a predominantly short observation unit length-of-stay distribution, thereby enabling actionable operational benchmarking. This framework is important because transparent, standardized indicator reporting is a prerequisite for comparing performance across time and institutions. Future work should, where feasible, link these dashboards to patient-level outcomes through governance-approved data linkage to enable risk-adjusted benchmarking and targeted pathway audits.

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Informed Consent: Not applicable. The study used only aggregated, de-identified institutional indicators and did not involve access to individual-level patient records

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References

1. Erenler AK, Akbulut S, Guzel M, Cetinkaya H, Karaca A, Turkoz B, et al. Reasons for overcrowding in the emergency department: experiences and suggestions of an education and research hospital. Turk J Emerg Med. 2016;14:59–63.
2. Roussel M, Teissandier D, Yordanov Y, Balen F, Noizet M, Tazarourte K, et al. Overnight stay in the emergency department and mortality in older patients. JAMA Intern Med. 2023;183:1378–85.
3. Eidstø A, Ylä-Mattila J, Tuominen J, Huhtala H, Palomäki A, Koivistoinen T. Emergency department crowding increases 10-day mortality for non-critical patients: a retrospective observational study. Intern Emerg Med. 2024;19:175–81.
4. Wretborn J, Wilhelms DB, Ekelund U. Emergency department crowding and mortality: an observational multicenter study in Sweden. Front Public Health. 2023;11:1198188.
5. Malmer G, Fällman A, Åhlberg R, Svensson P, Westerlund E, Ugglas BA. Individual patient sociodemographic characteristics are associated with waiting time to physician assessment in seven Swedish emergency departments: an observational 5-year cohort study of emergency department visits in the Stockholm Region. J Am Coll Emerg Physicians Open. 2025;6:100250.
6. Chou SC, Luo AD, Lee AH, Meguerdichian DA, Baugh CW. Trends in observation care and the growth of dedicated emergency department observation units: an analysis of the national hospital ambulatory medical care survey, 2007-2022. J Am Coll Emerg Physicians Open. 2025;6:100218.
7. Hayden EM, Grabowski BG, Kishen EB, Zachrison KS, White BA. The value of an emergency medicine virtual observation unit. Ann Emerg Med. 2024;84:261–9.
8. Hocagil AC, Bildik F, Kılıçaslan İ, Hocagil H, Karabulut H, Keleş A, et al. Evaluating unscheduled readmission to emergency department in the early period. Balkan Med J. 2016;33:72–9.
9. Zeytin AT, Cevik AA, Acar N, Kaya S, Ozcelik H. Characteristics of patients presenting to the academic emergency department in central Anatolia. Turk J Emerg Med. 2016;14:75–81.
10. Almasi S, Rabiei R, Moghaddasi H, Vahidi-Asl M. Emergency department quality dashboard; a systematic review of performance indicators, functionalities, and challenges. Arch Acad Emerg Med. 2021;9:e47.
11. Sibbritt D, Isbister GK, Walker R. Emergency department performance indicators that encompass the patient journey. Qual Manag Health Care. 2006;15:27–38.
12. Schull MJ, Guttmann A, Leaver CA, Vermeulen M, Hatcher CM, Rowe BH, et al. Prioritizing performance measurement for emergency department care: consensus on evidence-based quality of care indicators. CJEM. 2011;13:300–9.
13. Elshove-Bolk J, Mencl F, van Rijswijck BT, Simons MP, van Vugt AB. Validation of the Emergency Severity Index (ESI) in self-referred patients in a European emergency department. Emerg Med J. 2007;24:170–4.
14. Honigman LS, Wiler JL, Rooks S, Ginde AA. National study of non-urgent emergency department visits and associated resource utilization. West J Emerg Med. 2013;14:609–16.
15. Guttmann A, Schull MJ, Vermeulen MJ, Stukel TA. Association between waiting times and short term mortality and hospital admission after departure from emergency department: population based cohort study from Ontario, Canada. BMJ. 2011;342:d2983.
16. Nyce A, Gandhi S, Freeze B, Bosire J, Ricca T, Kupersmith E, et al. Association of emergency department waiting times with patient experience in admitted and discharged patients. J Patient Exp. 2021;8:23743735211011404.
17. Nahab F, Leach G, Kingston C, Mir O, Abramson J, Hilton S, et al. Impact of an emergency department observation unit transient ischemic attack protocol on length of stay and cost. J Stroke Cerebrovasc Dis. 2012;21:673–8.
18. Perry M, Franks N, Pitts SR, Moran TP, Osborne A, Peterson D, et al. The impact of emergency department observation units on a health

system. Am J Emerg Med. 2021;48:231–7.

19. Sun BC, McCreath H, Liang LJ, Bohan S, Baugh C, Ragsdale L, et al. Randomized clinical trial of an emergency department observation syncope protocol versus routine inpatient admission. Ann Emerg Med. 2014;64:167–75.
20. Chan AH, Ho SF, Fook-Chong SM, Lian SW, Liu N, Ong ME. Characteristics of patients who made a return visit within 72 hours to the emergency department of a Singapore tertiary hospital. Singapore Med J. 2016;57:301–6.
21. Cheng J, Shroff A, Khan N, Jain S. Emergency department return visits resulting in admission: do they reflect quality of care? Am J Med Qual. 2016;31:541–51.
22. Pham JC, Kirsch TD, Hill PM, DeRuggerio K, Hoffmann B. Seventy-two-hour returns may not be a good indicator of safety in the emergency department: a national study. Acad Emerg Med. 2011;18:390–7.