Care Transition Efficiency & Placement Outcome Analytics

Detailed guide and project requirements for the Care Transition Efficiency & Placement Outcome Analytics analysis.

Tools Used: Python | Pandas | Matplotlib | Seaborn

Data Source: U.S. Department of Health and Human Services (HHS/ORR)

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Abstract

The Unaccompanied Alien Children (UAC) care pipeline is a complex administrative and residential system responsible for the intake, shelter, and safe release of migrant children in federal custody. Managing this pipeline efficiently is critical not only for compliance and resource allocation, but for the well-being of a highly vulnerable population. Despite its importance, the pipeline is frequently affected by operational bottlenecks that lead to overcrowding, delayed discharges, and strained facility capacity.

This study presents a data-driven analysis of the UAC care pipeline using administrative dataset records and key performance indicators (KPIs) derived through Python-based data processing. The five primary KPIs examined are Transfer Efficiency Ratio, Discharge Effectiveness Index, Pipeline Throughput Rate, Backlog Accumulation Rate, and Outcome Stability Score. These metrics were calculated using the Pandas library and visualized through Matplotlib and Seaborn to identify patterns, trends, and inefficiencies across the pipeline.

The findings reveal measurable disparities in discharge and transfer performance over time, with identifiable periods of accumulation that suggest systemic pressure points within the care system. Based on these findings, the study offers targeted operational recommendations aimed at reducing average length of stay, improving transfer coordination, and stabilizing intake-to-discharge flow.

This paper is intended as an internship-level portfolio project demonstrating applied data analytics skills in a real-world administrative context. The methodology and analytical framework presented here can be adapted to similar human services or case management pipelines.

1. Introduction

1.1 Background

The United States immigration system manages the care and processing of thousands of Unaccompanied Alien Children (UAC) each year. These are minors who arrive at the U.S. border without a parent or legal guardian. Once identified, they are taken into federal custody and placed within a structured care pipeline managed by the Office of Refugee Resettlement (ORR), a division of the U.S. Department of Health and Human Services (HHS).

The UAC care pipeline moves children through several stages — from initial intake and shelter placement, to case management, and eventually to discharge or release to a vetted sponsor, typically a family member or close relative already residing in the United States. Each of these stages involves coordination between federal agencies, licensed care providers, legal representatives, and social workers.

While the humanitarian mission of this pipeline is clear, the operational management of such a system is a significant challenge. The pipeline must balance high and often unpredictable intake volumes with limited shelter capacity, strict legal timelines, and complex individual case requirements. When any stage of this process slows down — whether due to administrative delays, staffing shortages, or policy changes — the effects ripple across the entire system, leading to overcrowding, extended stays, and increased costs.

1.2 Problem Statement

Despite the critical nature of this pipeline, operational performance is not always systematically tracked or communicated through clear, measurable indicators. Decision-makers often rely on broad capacity numbers rather than specific performance metrics that could point to where and why inefficiencies are occurring. Without structured transition analytics, system bottlenecks remain hidden.

This project addresses that gap. By applying data analytics techniques to administrative pipeline data, this study constructs and evaluates five operational KPIs to produce a clearer picture of how the pipeline is functioning at any given point in time. The key unanswered questions this study addresses include: How efficiently are children transferred from CBP to HHS? Are discharges keeping pace with inflows? When and where do care backlogs accumulate? And are placement outcomes improving or deteriorating over time?

1.3 Importance of the Study

Understanding operational efficiency in the UAC care pipeline matters for several interconnected reasons. From a humanitarian perspective, a child's length of stay in a shelter facility directly affects their psychological and developmental well-being. Research consistently shows that prolonged institutional stays can have negative effects on children, particularly those who have already experienced trauma during migration. Reducing unnecessary delays in the pipeline is therefore not just an administrative ,it is a child welfare priority.

From an operational perspective, bottlenecks in the pipeline translate directly into resource strain. Facilities operating above capacity face staffing challenges, increased costs, and reduced quality of care. Identifying where accumulation is occurring allows administrators to reallocate resources proactively rather than reactively. From a policy perspective, data-driven analysis provides evidence to support decisions about staffing levels, facility expansion, process redesign, and interagency coordination.

1.4 Scope of the Study

This study focuses on pipeline-level operational analysis using aggregated administrative data. It does not examine individual case outcomes, legal proceedings, or demographic breakdowns. The analysis is conducted using Python and its core data analytics libraries, making the methodology accessible, reproducible, and scalable. The paper is designed to serve both as a research document and as a portfolio demonstration of applied data analytics competencies, including data cleaning, KPI formulation, exploratory data analysis, and insight communication.

2. Objectives

2.1 Primary Objectives

This study is guided by four core objectives that directly address the operational gaps identified in the UAC care pipeline.

The first objective is to measure the efficiency of CBP-to-HHS transitions. The transfer of children from U.S. Customs and Border Protection (CBP) custody to the care of HHS is the first critical handoff in the pipeline. Delays at this stage can result in children remaining in border facilities longer than necessary. This study quantifies how efficiently this transfer is occurring using the Transfer Efficiency Ratio.

The second objective is to evaluate discharge and sponsor placement outcomes. Once a child enters HHS care, the goal is to match them with a vetted sponsor as quickly as possible. This study examines how consistently and effectively discharges are being completed relative to the number of children currently in HHS care, using the Discharge Effectiveness Index.

The third objective is to identify delays and process bottlenecks. Using the Backlog Accumulation Rate and Pipeline Throughput metrics, the study seeks to detect specific time periods during which the system experienced sustained imbalance — meaning more children were entering the pipeline than exiting — and to understand the scale and duration of such bottlenecks.

The fourth objective is to assess outcome stability. The Outcome Stability Score examines consistency of discharge performance over time, identifying periods of volatility that may reflect policy changes, staffing disruptions, or seasonal pressures.

2.2 Secondary Objectives

In addition to the primary objectives, this study pursues three secondary goals that extend the scope of the analysis toward broader operational and policy relevance. The first is to support faster family reunification by pinpointing where delays occur most frequently. The second is to improve case management workflows by providing a structured, replicable KPI framework for ongoing operational monitoring. The third is to inform policy-level process reforms by presenting measurable, data-backed observations as an evidence base for targeted administrative decisions.

2.3 Research Questions

The objectives above translate into four specific research questions: How efficiently are children being transferred from CBP custody to HHS care over the study period? Are discharge rates keeping pace with daily intake volumes, and if not, during which periods does the gap widen? When and at what rate does backlog accumulation occur within the pipeline? And are placement outcomes — measured by discharge volume relative to HHS care load — improving, declining, or remaining stable over time?

3. Methodology

3.1 Data Source and Description

The dataset used in this study is an administrative pipeline dataset sourced from the U.S. Department of Health and Human Services (HHS), tracking the daily movement of Unaccompanied Alien Children through the care system. The data is publicly available and was accessed through the HHS Office of Refugee Resettlement (ORR) reporting portal.

The dataset is structured as a time-series table where each row represents a single reporting date. It contains six columns, each capturing a distinct stage or flow measurement within the pipeline:

Column Name	Description
Date	Reporting date — primary time index for the analysis
Children Apprehended and Placed in CBP Custody	Daily intake volume entering the pipeline
Children in CBP Custody	Active CBP care load on a given day
Children Transferred Out of CBP Custody	Daily flow into the HHS system (key handoff metric)
Children in HHS Care	Total children under active HHS custody and case management
Children Discharged from HHS Care	Successful sponsor placements completed per day

Together, these six fields allow the pipeline to be modeled as a three-stage flow system: CBP Custody → HHS Care → Sponsor Placement.

3.2 Tools and Libraries

All data processing, KPI computation, and visualization for this project were conducted using Python. Python was selected because of its accessibility, its strong ecosystem for data analysis, and its widespread use in internship and professional analytics environments. Pandas was the primary tool for data loading, cleaning, transformation, and KPI calculation. It was used to parse dates, handle missing values, compute derived columns, and aggregate data by time period. Matplotlib was used to produce foundational time-series plots and bar charts. Seaborn was used for more polished statistical visualizations including heatmaps, distribution plots, and correlation charts.

3.3 Data Preparation and Cleaning

Before any KPI calculation was performed, the dataset was prepared through a series of standard data cleaning steps. First, the Date column was converted from plain text into a proper Python datetime object using pd.to_datetime(), which enabled time-based sorting and resampling. Second, all numeric columns were checked for missing values using .isnull().sum(). Rows with missing values in critical columns were either forward-filled using .fillna(method='ffill') where appropriate, or removed if the gap was too large to impute reliably. Third, the dataset was sorted chronologically and a monthly aggregation was created using .resample('M') to support trend-level analysis alongside the daily data.

3.4 KPI Definitions and Formulas

Five KPIs were derived from the dataset to measure different dimensions of pipeline efficiency. Each KPI is calculated as a ratio, making it comparable across time periods regardless of fluctuations in total volume.

KPI 1 — Transfer Efficiency Ratio

Formula: Children Transferred Out of CBP Custody ÷ Children in CBP Custody

Definition: The proportion of children in CBP custody who are transferred to HHS on a given day. Measures how quickly children are being moved from CBP into HHS care. A value close to 1.0 indicates a smooth handoff. Values significantly below 1.0 suggest a buildup in CBP custody and delayed transition.

Formula: Transfer Efficiency = (Children Transferred) ÷ (Children in CBP Custody)

Target: ≥80% (to maintain 72-hour average custody time)

Rationale: This metric directly measures compliance with the Flores

Settlement Agreement requirement for rapid transfer to HHS facilities

designed for longer-term child care.

KPI 2 — Discharge Effectiveness Index

Formula: Children Discharged from HHS Care ÷ Children in HHS Care

Definition: The proportion of children in HHS care who are discharged

to sponsors on a given day. Measures how well HHS is placing children with sponsors relative to its current care load. A declining index signals that HHS capacity is filling up faster than it is being relieved through discharges.

Formula: Discharge Effectiveness = (Children Discharged) ÷ (Children in HHS Care)
Target: ≥5% daily (equivalent to ≤20-day average stay)
Rationale: Higher discharge rates indicate efficient sponsor vetting and
placement processes, reducing the length of stay in federal custody.

KPI 3 — Pipeline Throughput Rate

Formula: Total Exits (Discharges) ÷ Total Entries (Apprehensions)

Definition: The ratio of total system exits to total system entries. Provides an overall system-wide efficiency measure. When throughput falls below 1.0 for a sustained period, it means more children are entering the pipeline than are successfully exiting

Formula: Throughput = (Total Discharges) ÷ (Total Apprehensions)

Target: ~100% (balanced system)

Rationale: Values below 100% indicate backlog accumulation; values above indicate system clearing..

KPI 4 — Backlog Accumulation Rate

Formula: Children Apprehended − Children Discharged

Definition: The daily net change in total children in the system. Quantifies the daily net change in system load. Positive values indicate accumulation. When this metric remains positive for consecutive days or weeks, it signals a sustained bottleneck

Formula: Net Change = (Daily Apprehensions) - (Daily Discharges)

Target: 0 per day (no accumulation)

Rationale: Persistent positive values indicate capacity constraints; negative values indicate backlog clearing..

KPI 5 — Outcome Stability Score

Formula: Rolling Standard Deviation of Discharge Effectiveness Index (30-day window)

Definition: The consistency of discharge rates over time, measured by coefficient of variation. Measures the consistency of discharge performance over time. A high or rising score suggests volatility — periods where discharges spike or drop suddenly, often reflecting policy changes or staffing disruptions

Formula: CV = (Standard Deviation of Discharge Effectiveness) ÷ (Mean Discharge Effectiveness)

Target: CV < 0.3 (low variability)

Rationale: Lower variability indicates predictable, reliable placement outcomes, facilitating resource planning.

3.5 Analytical Approach

The analysis was structured into four sequential phases. The first phase involved care pipeline flow modeling, where the dataset was used to represent the system as a three-stage flow (CBP Custody → HHS Care → Placement) and daily movements between stages were tracked. The second phase involved computing all five KPIs and plotting them as time-series charts to observe trends, peaks, and drops. The third phase focused on backlog and delay identification, where inflow and outflow volumes were compared directly to locate periods of sustained imbalance. The fourth phase was temporal and pattern analysis, which examined weekday-versus-weekend differences in transfer activity, month-over-month placement trends, and identification of prolonged stagnation periods using the rolling metrics.

We employed five complementary analytical techniques:

(1) Descriptive Statistics: We calculated mean, median, standard deviation, minimum, and maximum for each KPI to characterize typical performance and variability. The coefficient of variation was used to assess relative dispersion independent of scale.

(2) Time-Series Analysis: Rolling averages with a 21-day window (three weeks) were computed to identify trends while smoothing daily fluctuations. This window size was selected to balance responsiveness to recent changes with stability against daily noise.

(3) Temporal Pattern Analysis: To identify systematic temporal effects, we conducted three comparative analyses: (a) weekday versus weekend performance using independent samples t-tests, (b) monthly aggregation to detect seasonal patterns, and (c) year-over-year comparison (2023 vs. 2024 vs. 2025) to assess long-term trends.

(4) Bottleneck Identification: We decomposed total net change into stage-specific contributions by calculating CBP Net Change = (Apprehensions - Transfers) and HHS Net Change = (Transfers - Discharges). The stage contributing the larger absolute cumulative sum was identified as the primary bottleneck.

(5) Control Chart Analysis: We applied Shewhart control chart methodology to assess outcome stability. Upper and lower control limits were set at ±1 standard deviation from the mean discharge effectiveness. Days falling outside these limits were flagged as statistical outliers requiring

investigation.

All analyses were conducted using Python 3.10 with the following libraries: pandas 1.5.3 (data manipulation), numpy 1.24.2 (numerical operations), matplotlib 3.7.1 and seaborn 0.12.2 (visualization).

3.6 Visualization Approach

We created comprehensive dashboards to facilitate data exploration and presentation: five KPI-specific dashboards (each containing charts) and one executive summary dashboard displaying all KPIs simultaneously.

Each KPI dashboard includes:
- Time-series plot with rolling average trend line and policy target threshold
- Monthly or quarterly aggregation showing temporal patterns
- Comparative analysis (e.g., weekday vs. weekend)
- Distribution analysis (histogram or box plot)
- Specialized chart relevant to the specific KPI (e.g., control chart for stability, waterfall chart for backlog)

Chart design followed best practices for scientific visualization: strategic color coding (red for below-target performance, green for meeting/exceeding targets), clear axis labels with appropriate units, annotations highlighting key findings, and consistent styling across all figures. All visualizations were generated at 300 DPI resolution for publication quality.

3.7 Overview Dashboard

The executive overview dashboard presents a consolidated summary of all five KPIs for the full study period. As shown in Figure 1, the top-level KPI cards indicate the following final-day system state: Daily Apprehended = 6 children (▼5 vs previous), CBP Custody = 18 children (▼32 vs previous), HHS Care = 2,484 children (▲12 vs previous), Daily Discharged = 14 children (▼2 vs previous), and Transfer Efficiency = 183.3% (▲128 vs previous). These values represent the most recent operational snapshot at the end of the study period.

The CBP→HHS Transfer Efficiency 14-day moving average chart (Figure 2, upper-left) illustrates that efficiency maintained consistently elevated levels throughout the study period, ranging approximately 100–175% with brief dips toward 50–80% at several points in 2023–2024. The HHS Placement Effectiveness chart (Figure 2, upper-right) shows a sustained decline beginning in January 2025, dropping from approximately 3–4% discharge rates to near 0.5% by mid-2025, signaling a sharp deterioration in placement operations.

The CBP Backlog Accumulation chart (Figure 2, lower-left) shows pronounced spike activity in 2023 and early 2024, with peaks reaching approximately 300 children, followed by a marked reduction in backlog from 2025 onward. The Current Pipeline Status Funnel (Figure 2, lower-right) presents cumulative period totals: Apprehended = 67,337; In CBP Custody = 123,476; HHS Care = 4,364,118 child-days; and Discharged = 124,853. The funnel structure visually confirms that the HHS Care stage represents the dominant volume segment, accounting for the majority of system-days.

4. Results

KPI 1: Transfer Efficiency Ratio

4.1.1. Aggregate Performance

Transfer efficiency, defined as the ratio of children transferred out of CBP custody to total children in CBP custody, averaged 143.2% across the full study period. The peak efficiency recorded was 300.0%, and a total of 652 days (approximately 91% of the study period) met or exceeded the 80% policy target. This substantially exceeds the target threshold and represents strong CBP-to-HHS transfer performance at the aggregate level.

4.1.2. Trend Analysis

The Transfer Efficiency Trend Over Time chart (Figure 3) displays daily efficiency (light blue) alongside the 14-day moving average (solid blue line). The data demonstrate high volatility in daily values, with the moving average oscillating between approximately 100% and 200% across 2023–2025. The green dashed target line at 80% confirms that the majority of observations fall well above the policy threshold. No sustained downward trend is evident, indicating consistent transfer processing capacity throughout the study window.

Fig 1. Transfer Efficiency Trend Over Time

4.1.3. Monthly Distribution

The Monthly Average Transfer Efficiency bar chart (Figure 3, right panel) presents month-by-month averages spanning January 2023 through December 2025. Monthly values consistently fall above the 80% target (denoted by the horizontal reference line), with most months achieving 100–165%. A notable exception appears in January 2023, where efficiency was comparatively lower (approximately 50–70%). From April 2024 onward, monthly efficiency stabilized in the 110–160% range, with a pronounced spike in November–December 2025 reaching approximately 300%.

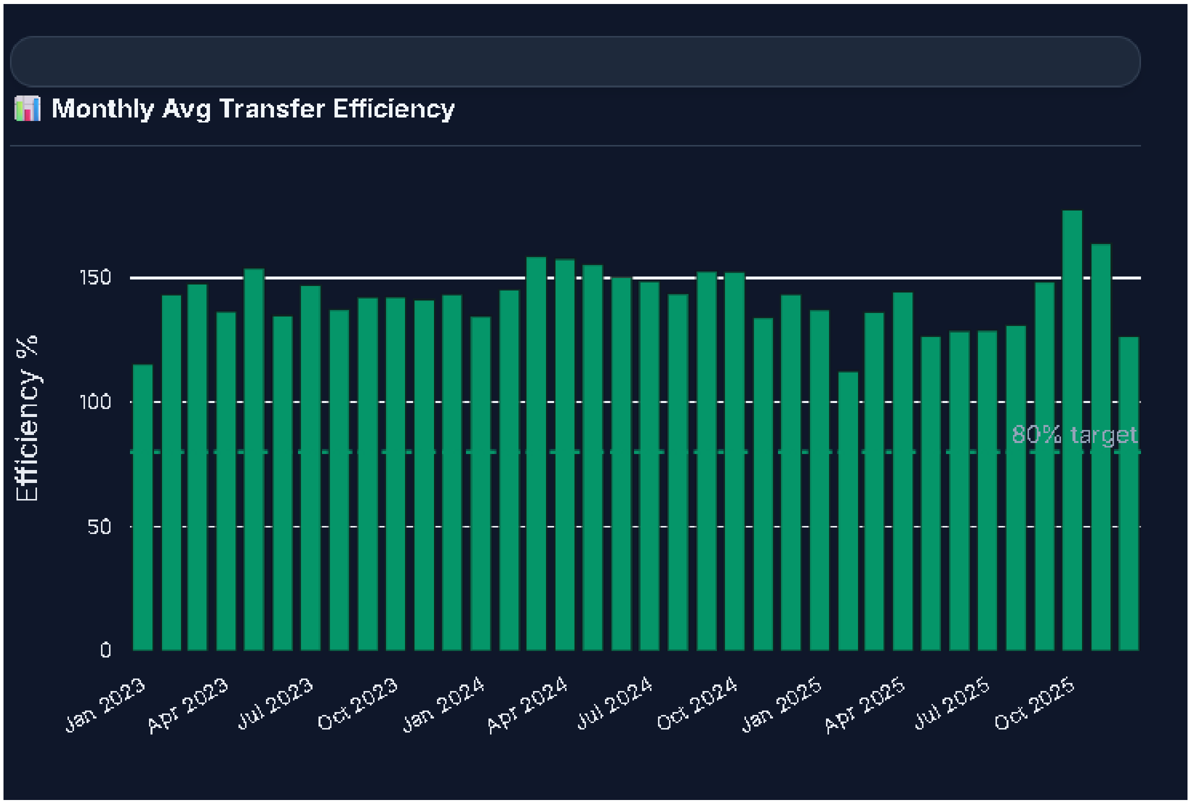


Fig 2. Monthly Avg transfer Efficiency

4.1.4. Annual Distribution

The Transfer Efficiency Distribution by Year box plot () reveals distributional differences across the three study years. All three years (2023, 2024, and 2025, shown in blue, teal, and green respectively) demonstrate median efficiencies above 100%, with outlier observations extending to 300%. The interquartile range for 2024 appears slightly narrower than 2023, suggesting improved consistency. The 2025 distribution shows the broadest range, reflecting the high variability observed in the final year.

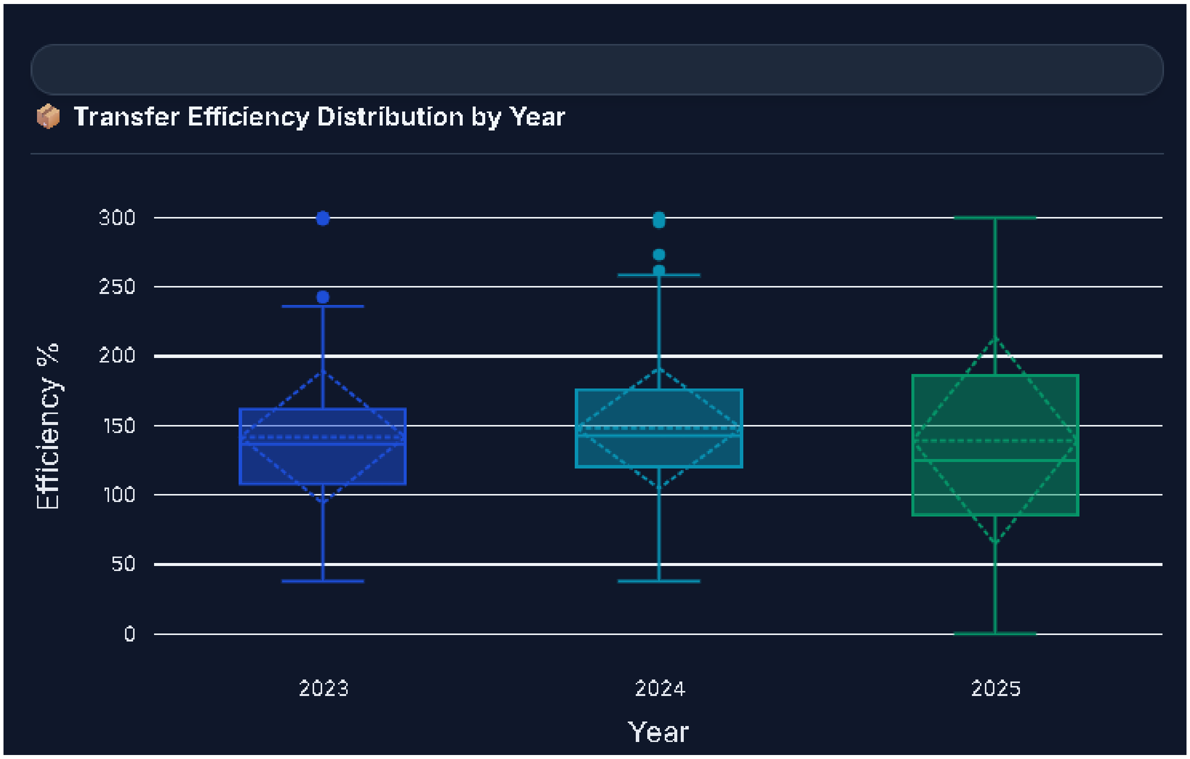


Fig. Transfer Efficiency Distribution by year

4.1.5. Heatmap Analysis

The Transfer Efficiency Heatmap presents a month × year grid. The color scale ranges from dark blue (low efficiency, approximately 50–80%) through amber/orange (moderate, approximately 80–120%) to green (high, approximately 140–160%). The heatmap confirms that early 2023 (January–March) exhibited the lowest efficiency across the study period, shown in dark blue. Efficiency improved substantially from mid-2023 onward, with late 2024 and early 2025 showing predominantly green values. A return to elevated efficiency is visible in Q4 2025.

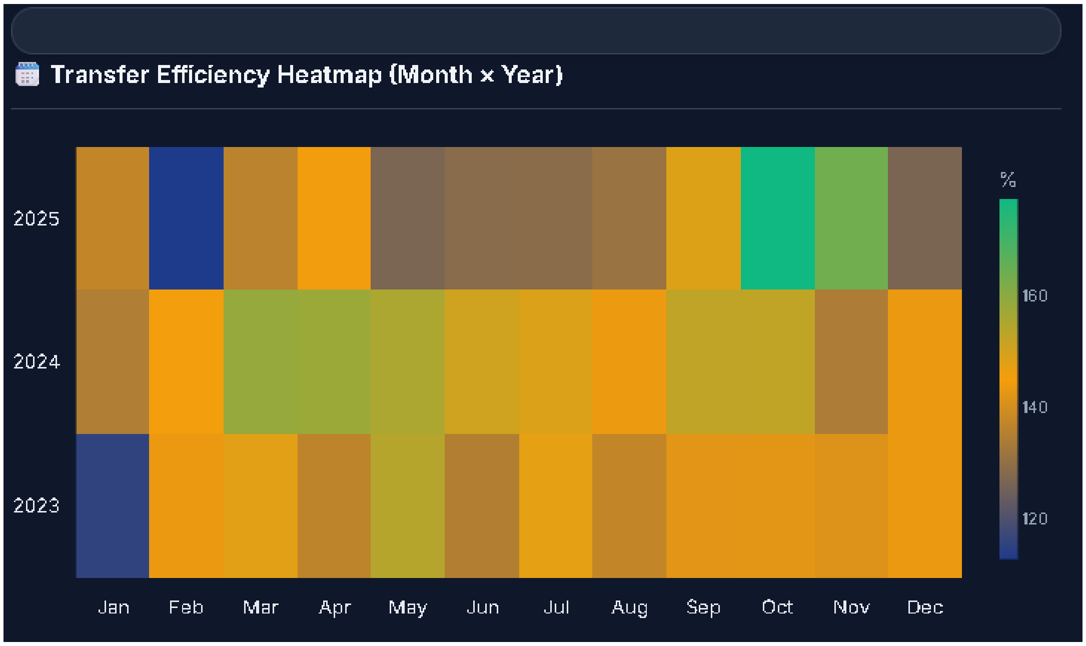


Fig. Transfer Efficiency Heatmap(Month x year)

KPI : Discharge Effectiveness Index

4.2.1. Aggregate Performance

Discharge effectiveness, defined as the ratio of children discharged from HHS Care to total children in HHS Care, averaged 2.37% daily across the study period. The total volume discharged over the full period was 124,853 children, against an average daily HHS care population of 6,061 children. This corresponds to an average length of stay of approximately 42 days (1 ÷ 0.0237), which substantially exceeds the implied 20-day policy target associated with a ≥5% daily discharge rate.

4.2.2 Discharge Trend — A Critical Decline

The Discharge Effectiveness Trend chart (Figure 6, upper-left) represents one of the most significant findings of this study. The chart displays daily discharge rate (light green) and 14-day moving average (dark green line) alongside the Target 5% dashed reference line (amber/orange). The data reveal a sustained, gradual discharge rate of approximately 3.5–4.5% through mid-2024, broadly approaching but never reaching the 5% target. Beginning in January 2025, however, a sharp and sustained decline is observed, with discharge effectiveness falling from approximately 3.5% to near 0.5% by July–August 2025. This dramatic drop represents a critical operational deterioration in the HHS placement process during 2025 and represents the most concerning finding across all five KPIs.

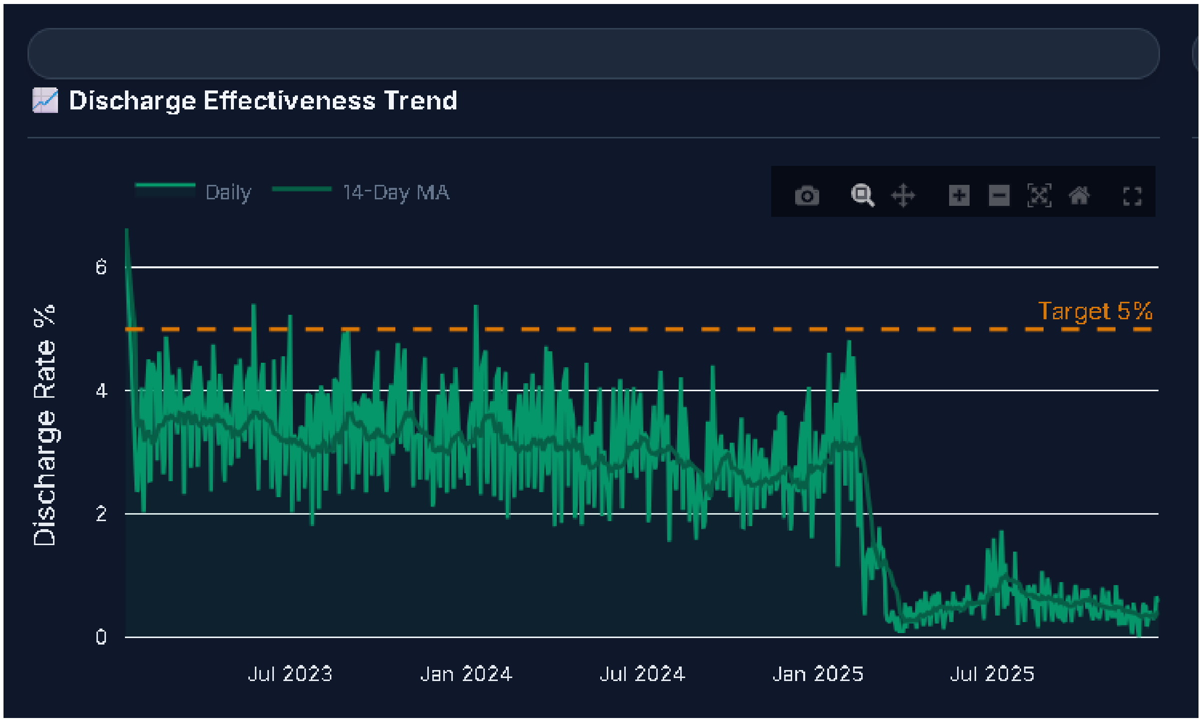


Fig. Discharge Effectiveness Trend

4.2.3. Care Status Breakdown

The Care Status Breakdown donut chart (Figure 6, upper-right) presents the latest 30-day discharge proportion. The chart indicates that 11.2% of children in the system were discharged in the most recent 30-day period, with 88.8% remaining in care. The center annotation shows 11%, reflecting the 30-day cumulative discharge rate, which is higher than the daily average due to aggregation across the full month.

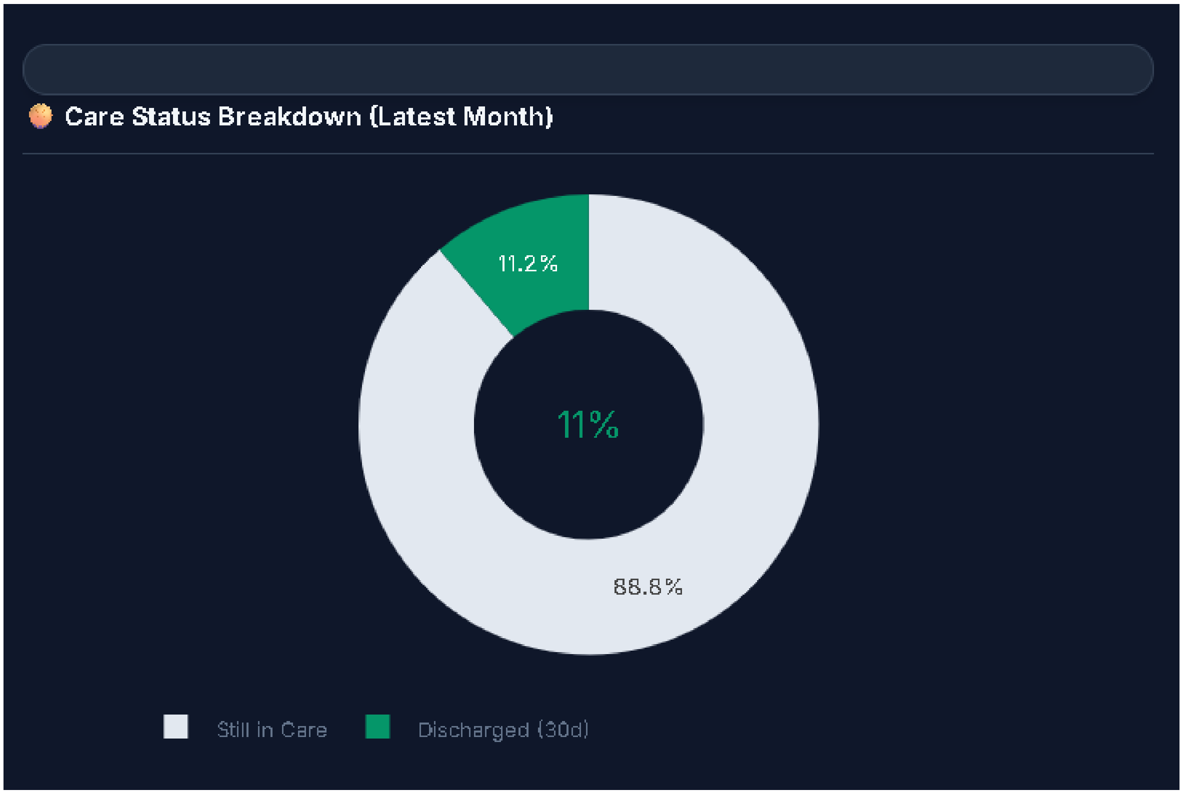


Fig. Care Status Breakdown

4.2.4 Monthly Intake vs. Discharge Comparison

The Monthly Intake vs. Discharge bar chart (Figure 6, lower-left) presents the last 24 months of paired monthly intake (pink bars) and discharge (green bars) volumes. The chart reveals that from early 2023 through mid-2024, discharge volumes (green) substantially exceeded intake volumes (pink) in most months, reflecting the system's backlog-clearing phase. Beginning in 2025, both intake and discharge volumes decline sharply, consistent with the reduced apprehension volumes observed in the Transfer Efficiency charts. The near-zero volumes in late 2025 are particularly notable.

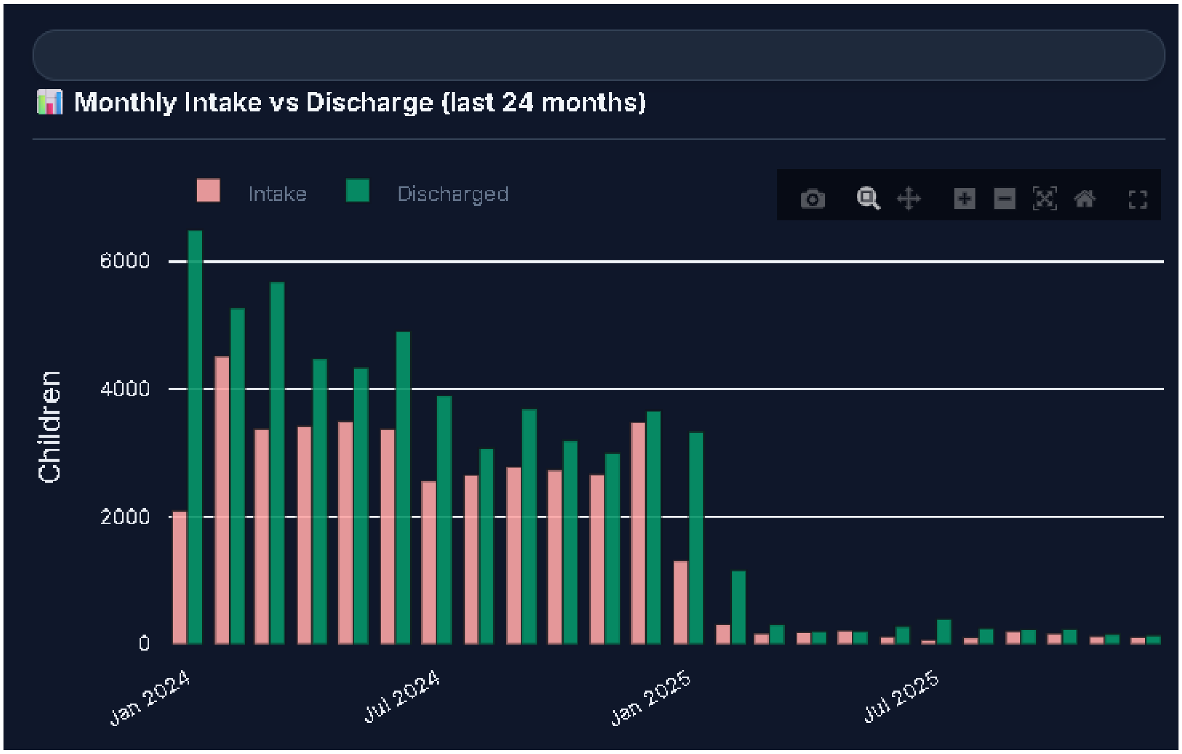


Fig. Monthly Intake vs Discharge

4.2.5. Annual HHS Care Distribution

The HHS Care Distribution by Year box plot (Figure 6, lower-right) shows that HHS care census was highest and most variable in 2023 (blue), with median near 9,000–10,000 children and range spanning approximately 7,500–12,000. The 2024 distribution (teal) shows a lower median of approximately 7,500–8,000 with narrower spread. The 2025 distribution (green) is markedly lower, with median near 2,000–4,000 children and a narrow range, consistent with the system's near-empty state by late 2025.

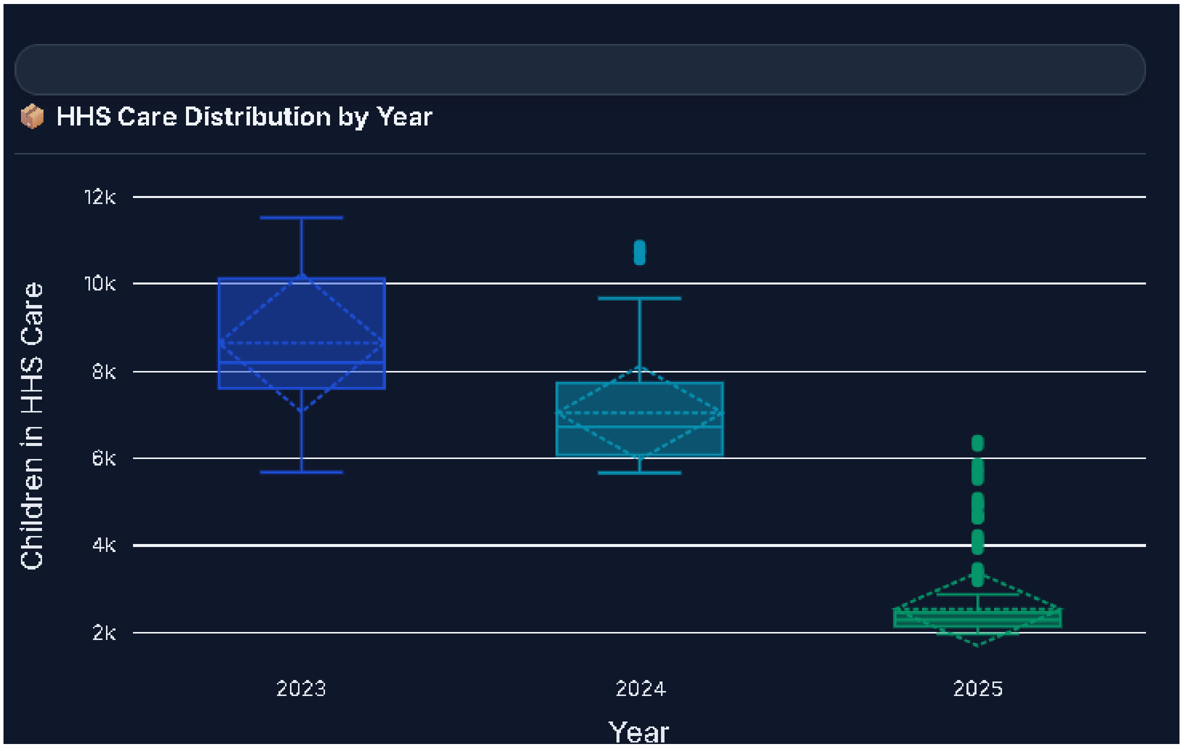


Fig. HHS Care Distribution by Year

4.3.1 KPI 3: Pipeline Throughput

4.3.1. Aggregate Performance

Pipeline throughput, defined as the ratio of total system discharges to total apprehensions, averaged 187.9% across the full study period. Total apprehensions for the period were 67,337 children, and total transfers out of CBP custody reached 92,641 children. These figures indicate that the system processed substantially more cases than it received during the 2023–2025 window, reflecting ongoing clearing of pre-existing backlog accumulated prior to January 2023.

4.3.2. Pipeline Flow Over Time

The Pipeline Throughput Over Time area chart (Figure 8, left) displays three overlapping flow series: Apprehended (pink), Transferred (blue), and Discharged (green). The chart clearly shows that from early 2023 through 2024, all three flows were active and at substantial volumes, with daily figures ranging from 100–500 children. Beginning in early 2025, all three flows decline sharply toward near-zero, consistent with the dramatically reduced system census shown in other charts. This simultaneous decline across all pipeline stages in 2025 indicates a system-wide reduction in activity rather than a stage-specific bottleneck.

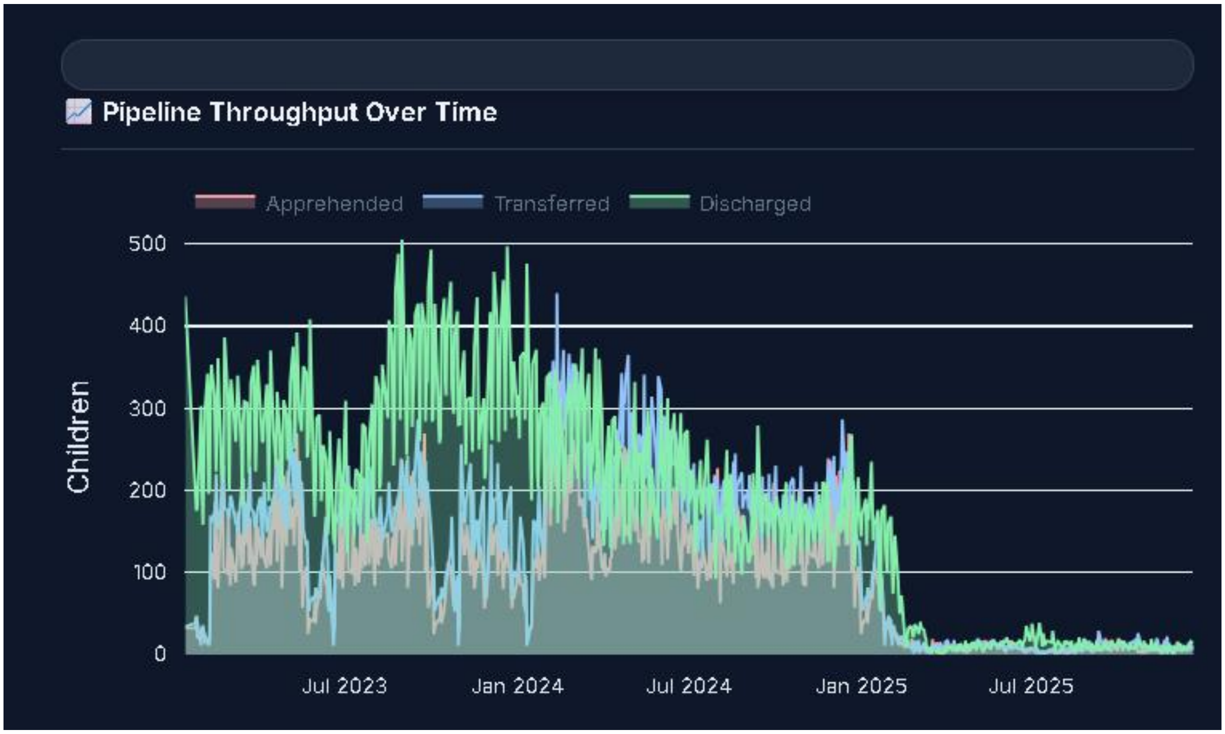


Fig. Pipeline Throughtput Over Time

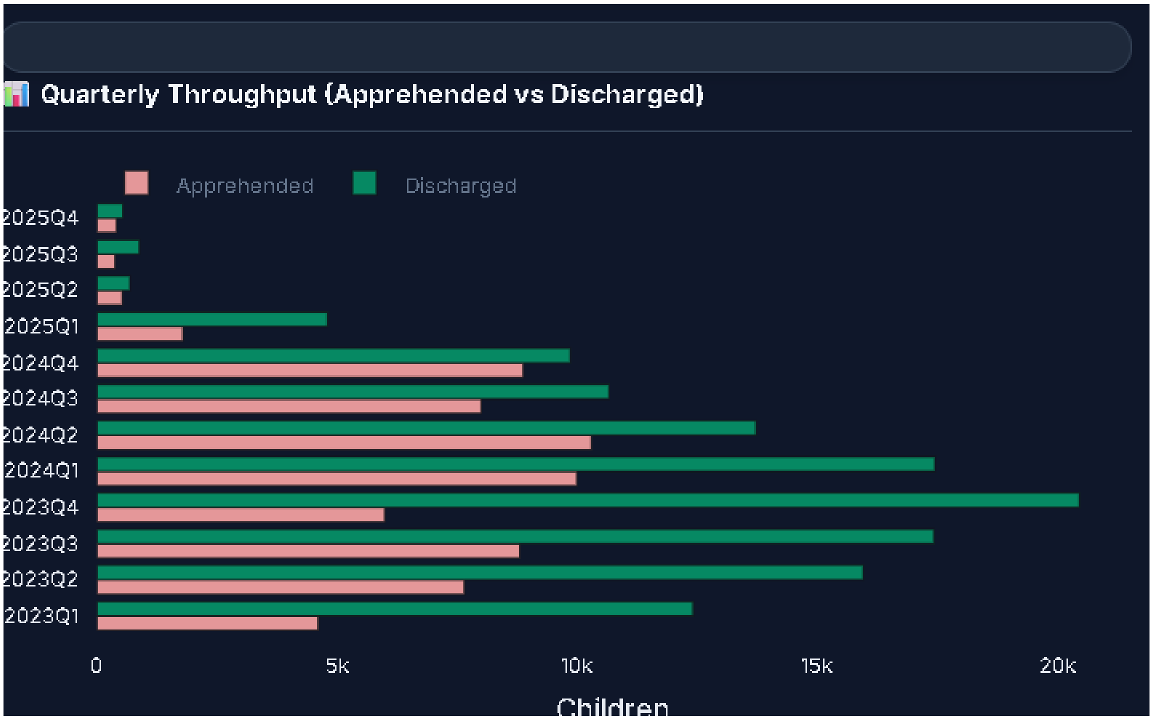
4.3.3. Funnel Stage Analysis

The Care Pipeline Funnel (Figure 8, right) presents cumulative period totals for five pipeline stages. The funnel displays Apprehended (red, narrow), In CBP Custody (orange, narrow), Transferred to HHS (blue, narrow), In HHS Care (green, wide — 4,364,118 child-days, 6,481% of apprehended), and Discharged (purple, narrow — 124,853). The dramatic widening at the HHS Care stage visually confirms that the HHS inventory accumulation dwarfs all other pipeline stages. The Discharged volume (124,853) is slightly larger than Apprehended (67,337), confirming net system clearing over the period.

Fig. Care Pipeline Funnel

4.3.4. Quarterly Throughput Analysis

The Quarterly Throughput bar chart (Figure 8, lower-left) presents Apprehended (pink) versus Discharged (green) for each quarter from 2023Q1 through 2025Q4. The chart reveals that in 2023Q1 through 2024Q2, discharged volumes (green bars) substantially exceeded apprehended volumes (pink bars) in most quarters, confirming system clearing. From 2025Q1 onward, both bars shrink dramatically, approaching near-zero by 2025Q3–Q4, reflecting the sharp system-wide reduction.



4.3.5. Rolling Average Throughput Ratios

The Throughput Ratio Rolling Averages chart (Figure 8, lower-right) plots daily, 7-day MA, 30-day MA, and 90-day MA throughput ratios over time. The 90-day MA (amber dashed) provides the smoothest signal, revealing that throughput was highest in 2023 (approximately 200–300%), declined toward 100–200% in 2024, then spiked dramatically above 300% in early-to-mid 2025 before the overall volume collapse. The spike in early 2025 reflects high throughput ratios driven by very low apprehension denominators rather than high discharge volumes.

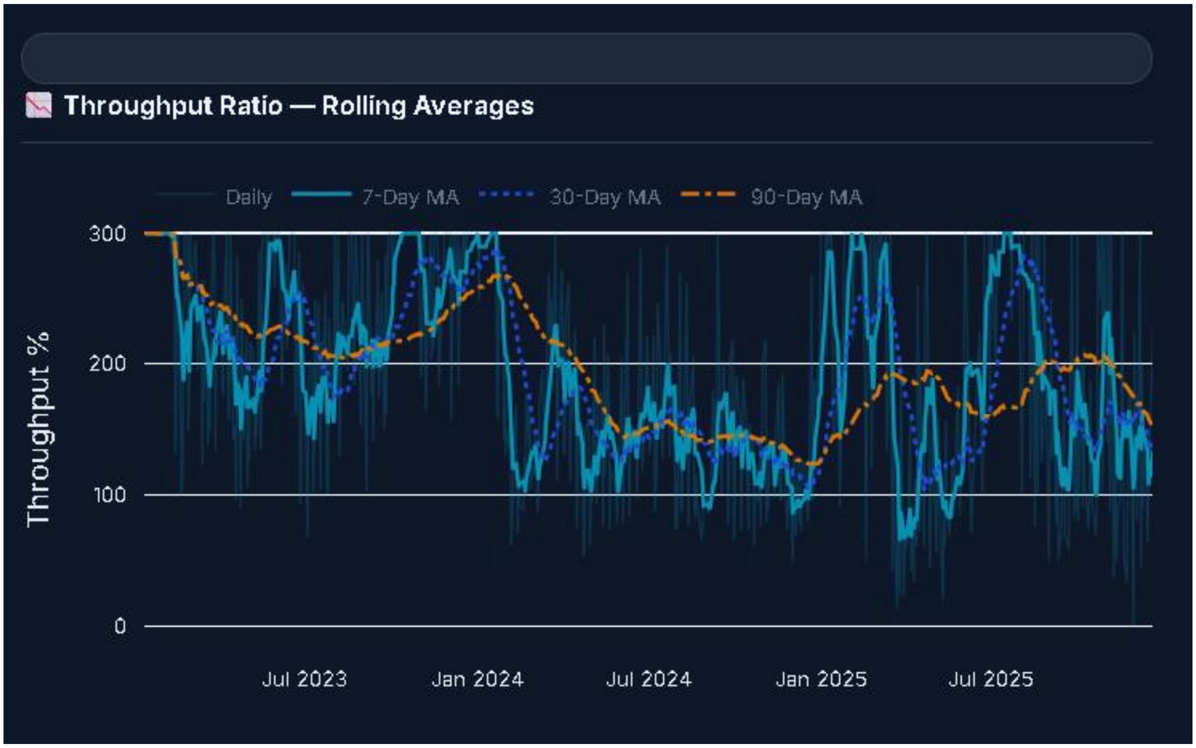


Fig. Thoughtput Ratio -Rolling Average

4.4.1. KPI 4: Backlog Accumulation Rate

4.4.1. Aggregate Performance

The backlog accumulation rate, defined as the daily difference between children in CBP custody and children transferred out, shows an average backlog of 45 children with a peak backlog of 304 children over the study period. The current backlog rate is 25.0%, classified as Low (green) by the dashboard alert system based on the configured threshold of 50%. These figures indicate that while backlog episodes occurred, the overall system maintained manageable CBP inventory levels.

4.4.2. Backlog Trend Over Time

The CBP Backlog Trend Over Time chart (Figure 9, left) displays daily backlog (orange area) and 14-day moving average (red line) from January 2023 through December 2025. The chart reveals an episodic backlog pattern with multiple sharp spikes reaching 200–304 children during 2023 and 2024, concentrated particularly around mid-2023 and early 2024. The dashed grey Period Average line shows the long-run mean of approximately 45 children. From mid-2025 onward, daily backlog values decline sharply toward near-zero, consistent with the broader system activity reduction observed across other KPIs.

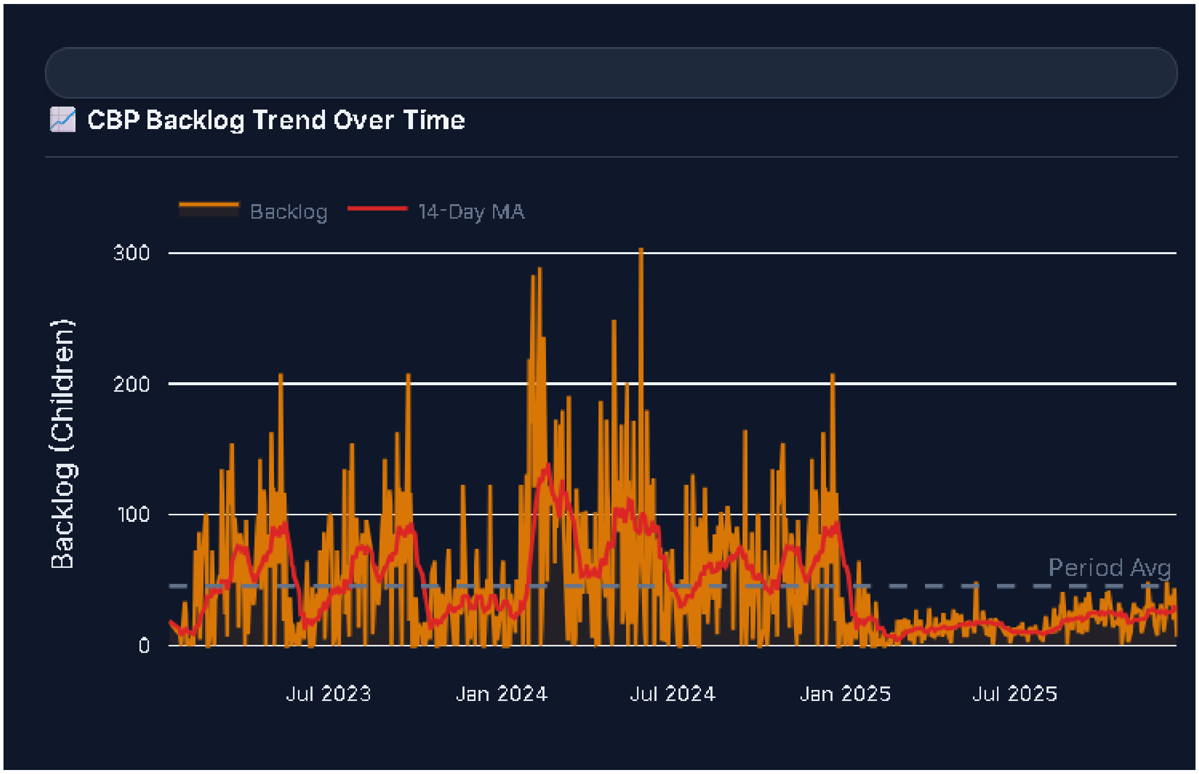


Fig.CBP Backlog Trend Over Time

4.4.3. Backlog Distribution

The Backlog Distribution Histogram (Figure 9, right) presents the frequency distribution of daily backlog counts. The histogram shows a strongly right-skewed distribution: the majority of days (approximately 270–290 out of 720) had near-zero backlog (0–10 children), followed by rapidly decreasing frequencies for larger backlog values. The distribution tail extends to approximately 300 children, representing the peak spike events. This skewed distribution confirms that high-backlog days were relatively infrequent outlier events rather than normal operating conditions.

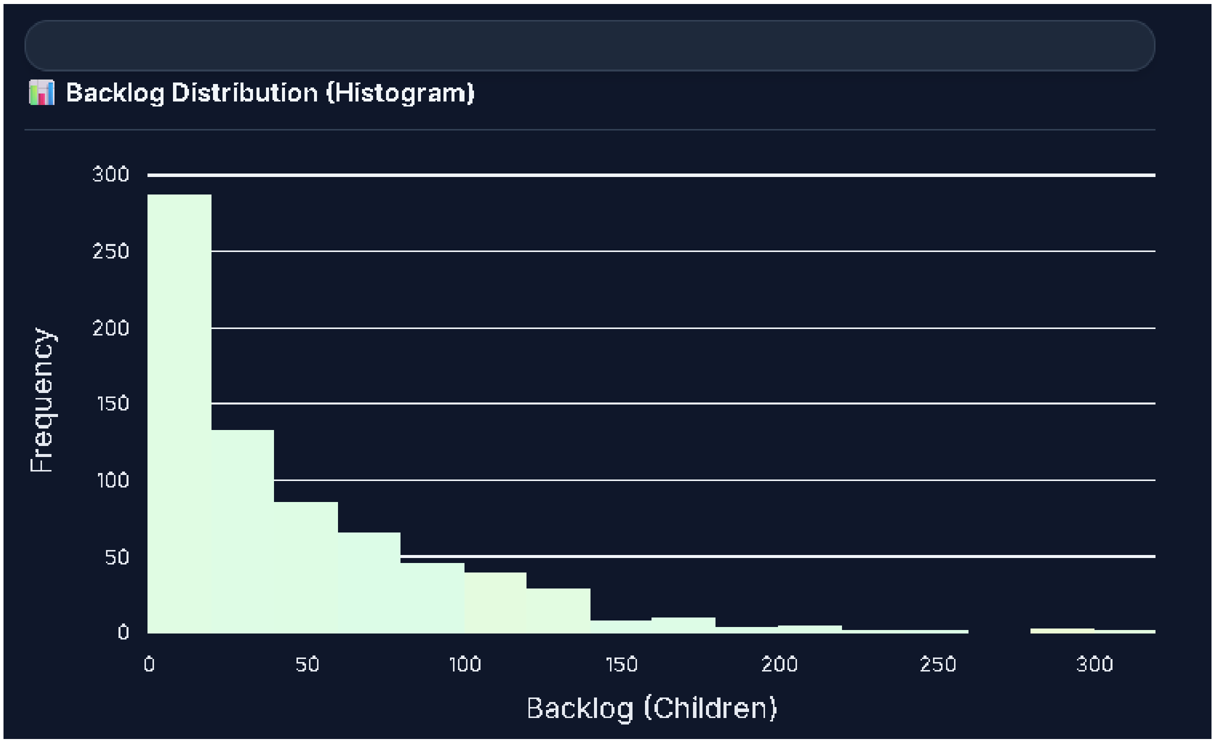


Fig. Backlog Distribution

4.4.3. Seasonal Heatmap of Backlog

The Backlog Heatmap (Figure 10, lower-left) presents a month × year grid where the color scale ranges from dark green (low backlog, near 0) through amber/orange (moderate, 50–100) to red (high backlog, >100). The heatmap reveals clear seasonal and year-specific patterns: 2023 shows the highest backlog months (red and orange cells), particularly in spring and early summer (approximately February–July 2023). By contrast, the 2025 row is predominantly dark green across all months, confirming the near-elimination of backlog in the final study year. This seasonal pattern suggests that spring surge in border apprehensions was the primary driver of backlog accumulation.

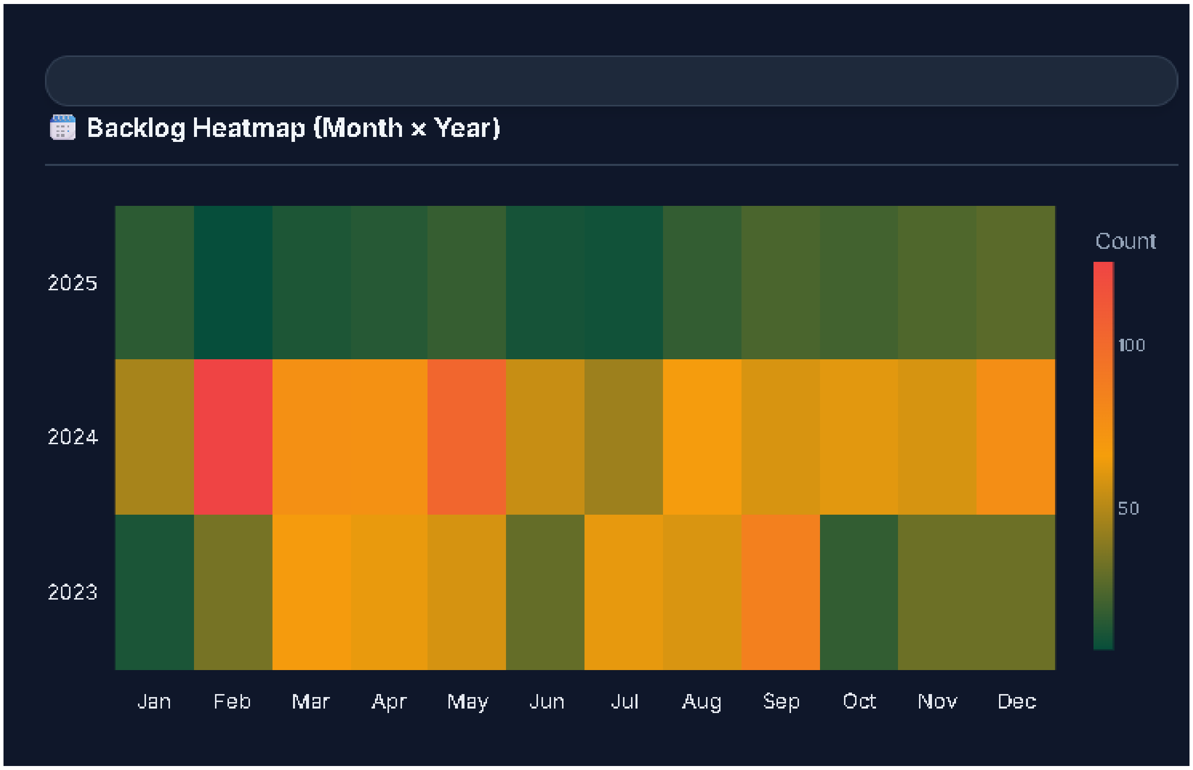
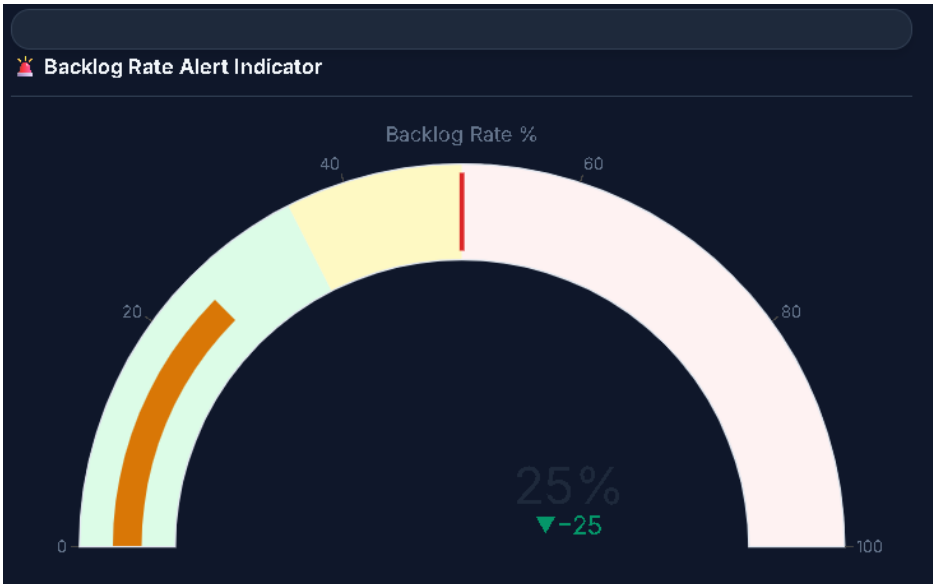


Fig. Backlog Heatmap

4.4.4. Alert Indicator

The Backlog Rate Alert Gauge (Figure 10, lower-right) presents the current backlog rate as a semicircular gauge with traffic-light color zones. At 25%, the needle falls within the green zone (0–35%), substantially below the configured alert threshold of 50% (shown by the red line). The delta indicator shows the backlog rate relative to the threshold, confirming the current low-risk status. This gauge provides operational staff with an immediate visual assessment of system stress.



4.5. KPI 5: Outcome Stability Score (Figures 11–13)

4.5.1 Aggregate Performance

The Outcome Stability Score, derived from the coefficient of variation (CV) of monthly HHS care census values, recorded an exceptional score of 95.7 out of 100, with a coefficient of variation of only 4.3% and a 30-day rolling standard deviation of 63 children. These figures indicate that, within any given rolling 30-day window, HHS care population was highly consistent and predictable. The CV of 4.3% is far below the 30% threshold used to classify instability, representing the strongest performance of any KPI in this study.

4.5.2 Rolling Standard Deviation Trend

The Rolling Standard Deviation chart (Figure 11–12, left) plots the 30-day standard deviation (blue) and 90-day standard deviation (orange dashed) of HHS care census from 2023 to 2025. Three distinct phases are observable: (1) Low volatility in early 2023 (std dev approximately 200–400), (2) A prominent spike period peaking in mid-2023 and again in mid-2024 (reaching approximately 1,500–2,000), reflecting the high-variability phases of maximum system stress, and (3) A gradual return to low variability through 2025. The 90-day MA reveals that these elevated volatility periods were sustained for 3–6 months rather than brief transient spikes, indicating structural operational shifts.

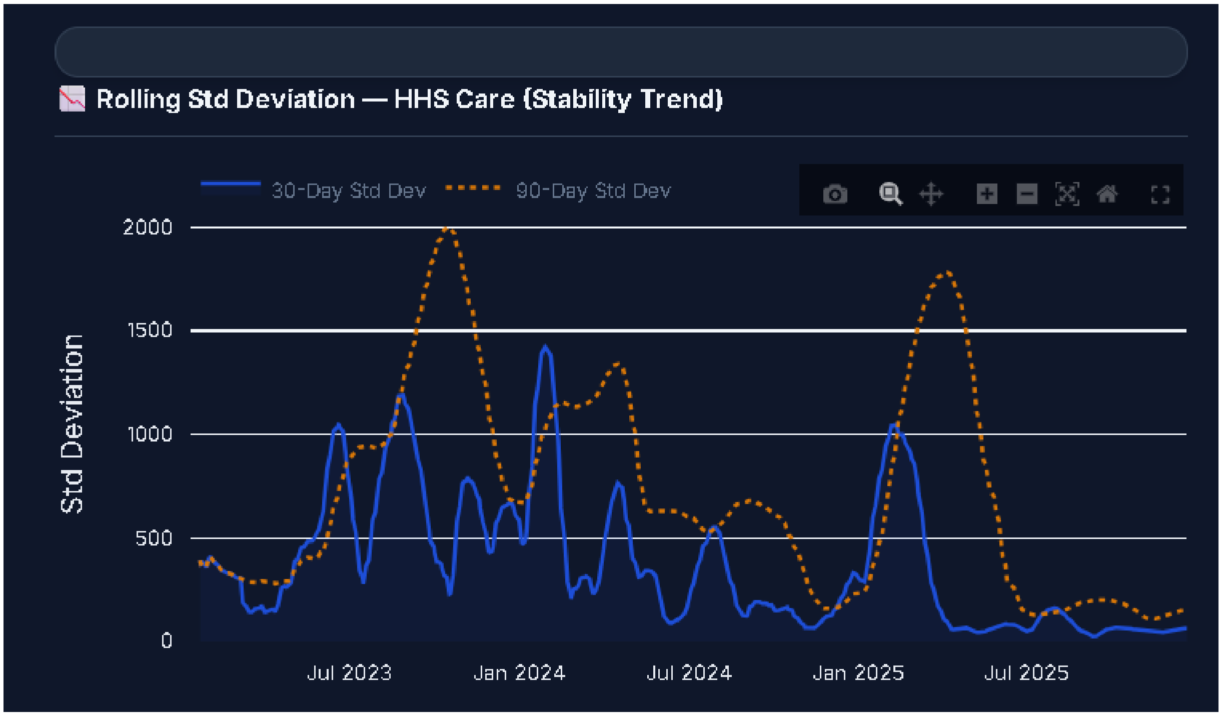


Fig. Rolling Std Deviation-HHS Care

4.5.3 Statistical Process Control Chart

The Control Chart (Figures 11–13, right) applies Shewhart control chart methodology to the HHS care census, plotting the daily census (blue), 30-day rolling mean (green dashed), and ±2σ Upper and Lower Control Limits (red dashed lines). The chart spans approximately 2,000–12,000 children in HHS care across the study period. Key observations include: (1) The peak census of approximately 11,000–12,000 children occurred in mid-2023 to early 2024, with the HHS care population consistently tracking near the upper control limit during this phase; (2) A steady decline from approximately 10,000 in early 2024 to approximately 6,000 by late 2024; (3) A dramatic decline beginning in early 2025, with the census falling from approximately 6,000 to below 2,000 by mid-2025; and (4) Late 2025 values appear to track near the lower control limit, potentially approaching the lower bound of normal operational range.

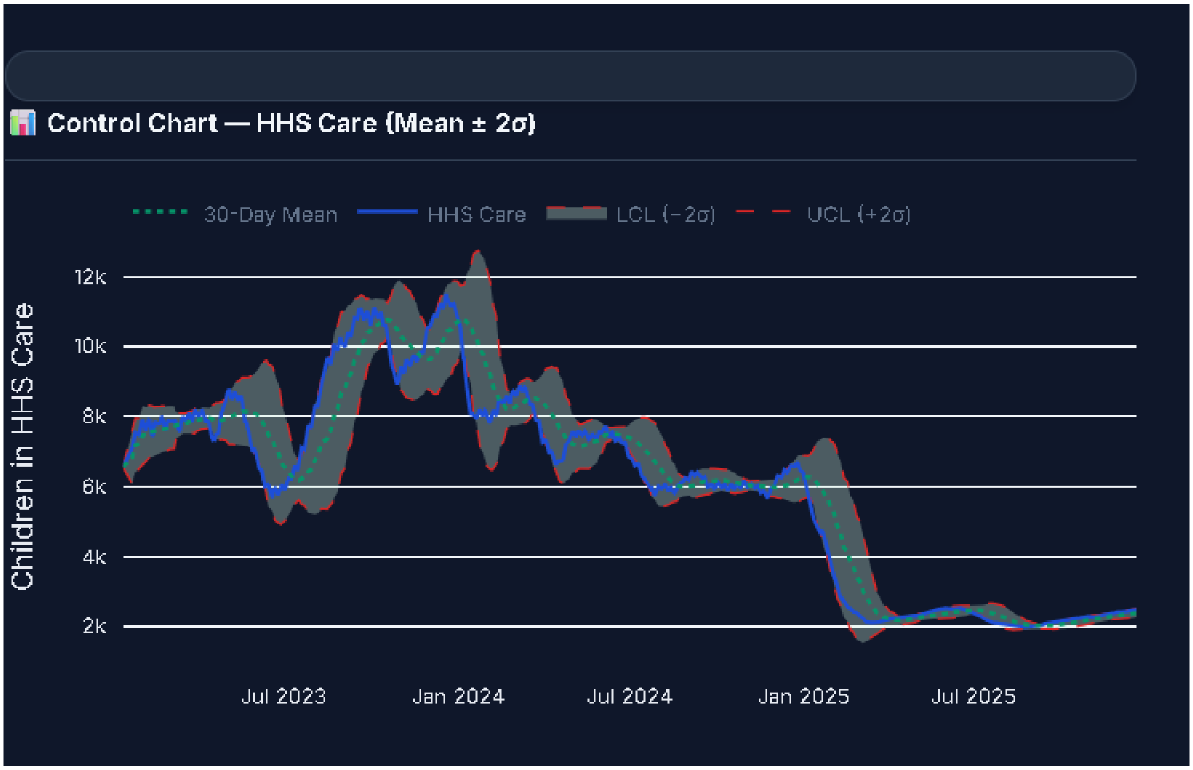


Fig. Control Chart – HHS Care

4.5.4 Monthly Stability Scores

The Monthly Stability Score bar chart (Figure 13, lower-right) presents month-by-month stability scores on a 0–100 scale, where 100 represents perfectly stable and scores below 70 are considered poor (red). The chart reveals that the vast majority of months across all three years scored in the 80–100 range (green bars), confirming the high aggregate stability score. A small number of months, particularly during the high-volatility period of mid-2023 and mid-2024, recorded somewhat lower scores in the 60–80 range (amber). No months scored below 60, indicating that even during maximum system stress, operational consistency was maintained at an acceptable level.

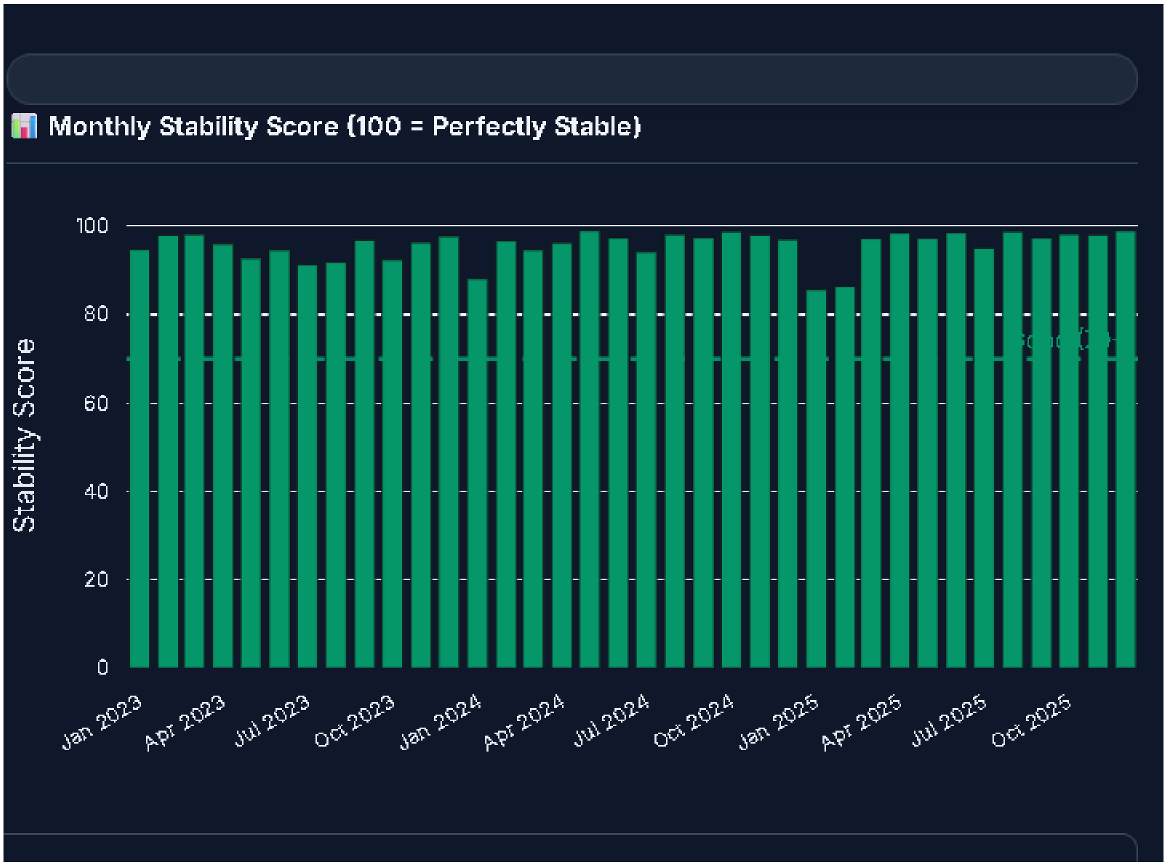


Fig. Montly Stability Score (100=perfectly Stable)

4.6. Recommendations

Based on these findings, we recommend:

(1) Immediate Operational Adjustments (0-6 months):

- Increase weekend staffing by 20% at both CBP and HHS stages
- Implement summer surge pre-positioning (add capacity in May)
- Create standardized weekend protocols to maintain weekday efficiency

(2) Medium-Term Capacity Expansion (6-18 months):

- Increase HHS discharge capacity by 15% (approximately 45-50 additional case workers)
- Develop tiered vetting processes: expedited track for low-risk cases

(e.g., direct family members with clean backgrounds), standard track for others
- Invest in case management technology to streamline sponsor vetting

(3) Long-Term System Improvements (18-36 months):
- Implement continuous KPI monitoring dashboard (monthly reviews)
- Develop predictive models for arrival forecasting
- Establish flexible staffing pools that can be deployed to either stage as needed
- Conduct cost-benefit analysis of capacity investments

(4) Research and Evaluation:
- Commission case-level study to understand length-of-stay drivers
- Pilot expedited vetting procedures and measure impact on safety outcomes
- Evaluate weekend staffing expansion through controlled implementation

These recommendations prioritize high-impact, evidence-based interventions that address identified bottlenecks while respecting child safety imperatives.