NARCTRACK — VALIDATION REPORT

Built to catch what others miss.

NarcTrack's diversion detection engine is validated against 1,004 real-world clinical scenarios across 26 pattern detectors — before any event reaches your providers.

1,004	100%	26	4
TEST CASES	PASS RATE	PATTERN DETECTORS	RISK DOMAINS

EXECUTIVE SUMMARY

A validation-first approach to diversion detection.

NarcTrack's diversion detection engine is not just tested at launch — it is re-validated against 1,004 clinical scenarios on every release. This report documents the methodology, coverage, and results of the current validation suite for Diversion Engine v2.0, giving your agency confidence that the system detecting issues in the field has been rigorously verified before it reaches you.

1,004	100%	26	4
Test Cases	**Pass Rate**	**Pattern Detectors**	**Risk Domains**
63 clinical categories	Zero failures, zero regressions	Independently validated	Access, Inventory, Behavioral, Geo

WHAT SETS THIS APART

Validation, not just testing.

Boundary-first design. Every numeric threshold is tested at exactly three points: threshold - 1, threshold, and threshold + 1. This eliminates the off-by-one false negatives that undermine most rule-based detection systems.

Drug-specific parametric coverage. Tests are not generic. Each drug — fentanyl, morphine, hydromorphone, oxycodone, midazolam, ketamine — has its own pharmacodynamic intervals, dosing parameters, and scheduling classification tested independently.

Compound scenario validation. 326 of the 1,004 cases test combinations of 2 to 6 simultaneous patterns, confirming that real-world multi-signal events score and escalate correctly without interference or double-counting.

Specificity, not just sensitivity. 28 test categories are dedicated to clean events — normal clinical activity that must not be flagged. A system that cries wolf is as dangerous as one that stays silent.

DETECTION FRAMEWORK

26 validated pattern detectors.

Each detector is independently tested against boundary conditions, real-world drug-specific parameters, and compound multi-pattern scenarios.

ACCESS DOMAIN — 6 DETECTORS

Off-Hours Access
Flags controlled substance movements outside a provider's established shift window, with graduated penalty by hours outside shift.

● Access Domain

High-Frequency Access
Detects movement counts exceeding 2x a provider's rolling 30-day average, surfacing access patterns inconsistent with patient load.

● Access Domain

Atypical Transfer Routes
Compares each drug movement origin-destination pair against the provider's established common routes. Unusual pairings are flagged.

● Access Domain

Rapid Successive Access
Triggers when consecutive controlled substance accesses occur fewer than 20 minutes apart, with elevated severity under 10 minutes.

● Access Domain

Shift-Boundary Activity
Monitors events within +/-15 minutes of shift handoff times (07:00 and 19:00 ET), a known high-risk window for diversion incidents.

● Access Domain

Chronic Shift-Boundary Pattern
Identifies providers whose events cluster near shift boundaries at a rate exceeding 30% of all events over 30 days.

● Access Domain

INVENTORY DOMAIN — 5 DETECTORS

Inventory Variance
Detects discrepancies between expected par levels and actual controlled substance counts. Schedule II drugs carry a 1.5x severity multiplier.

● Inventory Domain

Waste Documentation Gap
Flags any controlled substance administration event missing corresponding waste documentation — a direct DEA compliance indicator.

● Inventory Domain

Systematic Shrinkage
Identifies consistent, small-amount shortages across consecutive events — the hallmark of incremental diversion designed to avoid detection.

● Inventory Domain

Micro-Shortage Tracking
Tracks sub-10mg individual event shortages (0.1-9.9mg) below typical alert thresholds. Cumulative totals trigger elevated or critical flags at 50mg and 100mg.

● Inventory Domain

Concentration Verification
Compares recorded drug concentrations against the organization's controlled substance catalog. Deviations greater than 5% indicate possible substitution.

● Inventory Domain

DETECTION FRAMEWORK (CONTINUED)

Behavioral & geographic detectors.

BEHAVIORAL DOMAIN — 9 DETECTORS

Self-Witness Accountability
Detects when a provider records themselves as witness on their own controlled substance events — eliminating independent oversight.

● Behavioral Domain

Chronic Self-Witness Pattern
Escalates when self-witnessed events represent 3 or more occurrences in a 30-day window, indicating a structural accountability failure.

● Behavioral Domain

Pharmacodynamic Interval Validation
Validates that repeat administrations respect minimum safe intervals per drug class — fentanyl (20 min), morphine (30 min), oxycodone (45 min).

● Behavioral Domain

Peer Statistical Outlier Analysis
Computes z-scores against org-wide 30-day baselines. Providers more than 2 standard deviations above peers are flagged; 3+ is critical.

● Behavioral Domain

Sub-Therapeutic Dosing Detection
Identifies doses below 60% of weight-based minimums for fentanyl, morphine, midazolam, and ketamine — a key indicator of drug substitution.

● Behavioral Domain

Prior Alert History
Incorporates a provider's 30-day alert history as a behavioral context signal, with graduated impact up to 40 points for 4+ prior alerts.

● Behavioral Domain

Extended Custody Monitoring
Flags when a controlled substance box remains in a single provider's custody for more than 8 hours, with severity scaling beyond 16 hours.

● Behavioral Domain

Chronic Sub-Therapeutic Pattern
Escalates when a provider exceeds 5 sub-therapeutic dosing events in 30 days, indicating a systematic pattern rather than an isolated incident.

● Behavioral Domain

Peer Frequency Deviation
Benchmarks each provider's movement rate against the org mean and standard deviation, flagging significant outliers in access frequency.

● Behavioral Domain

GEOGRAPHIC DOMAIN — 3 DETECTORS

Location Anomaly Detection
Compares GPS coordinates of each drug movement against expected dispatch location. Events more than 500m off-location are escalated; beyond 3km is critical.

● Geographic Domain

Geospatial Impossibility Detection
Uses haversine calculations to identify physically impossible travel between consecutive GPS-logged events — a definitive indicator of falsified location data.

● Geographic Domain

Manual Override Monitoring
Flags events where location or system safeguards were manually overridden, providing a full audit trail of circumvention activity.

● Geographic Domain

VALIDATION METHODOLOGY

Rigorous by design.

Every release of the diversion engine runs against the full 1,004-case validation suite. No deployment ships with a regression. Below is how the suite is structured.

01

Boundary Condition Testing

Every numeric threshold in the engine is tested at threshold - 1, exactly at threshold, and threshold + 1. This covers 15 distinct boundary types across all detectors — eliminating off-by-one errors that produce false negatives at the exact edge.

02

Drug-Specific Parametric Sweeps

Each controlled substance has unique pharmacodynamic intervals, dosing guidelines, and scheduling classifications. Tests are generated per drug — fentanyl, morphine, hydromorphone, oxycodone, midazolam, ketamine, and more.

03

Compound Pattern Validation

Real diversion rarely involves a single flag. The suite includes 326 compound tests — 2-pattern through 6-pattern combinations — confirming that multi-signal events score and escalate correctly without pattern interference or double-counting.

04

Isolated Mock Data Injection

Detectors that depend on historical database state use injected mock fixtures. Each test runs against a known, controlled state, making results deterministic and reproducible across environments.

05

Clean Event Verification

28 clean-event test categories confirm the engine does not flag normal clinical activity. Tests span all controlled drug classes, mid-shift hours, standard routes, and correct dose ranges — validating specificity alongside sensitivity.

06

Risk Level Escalation Tests

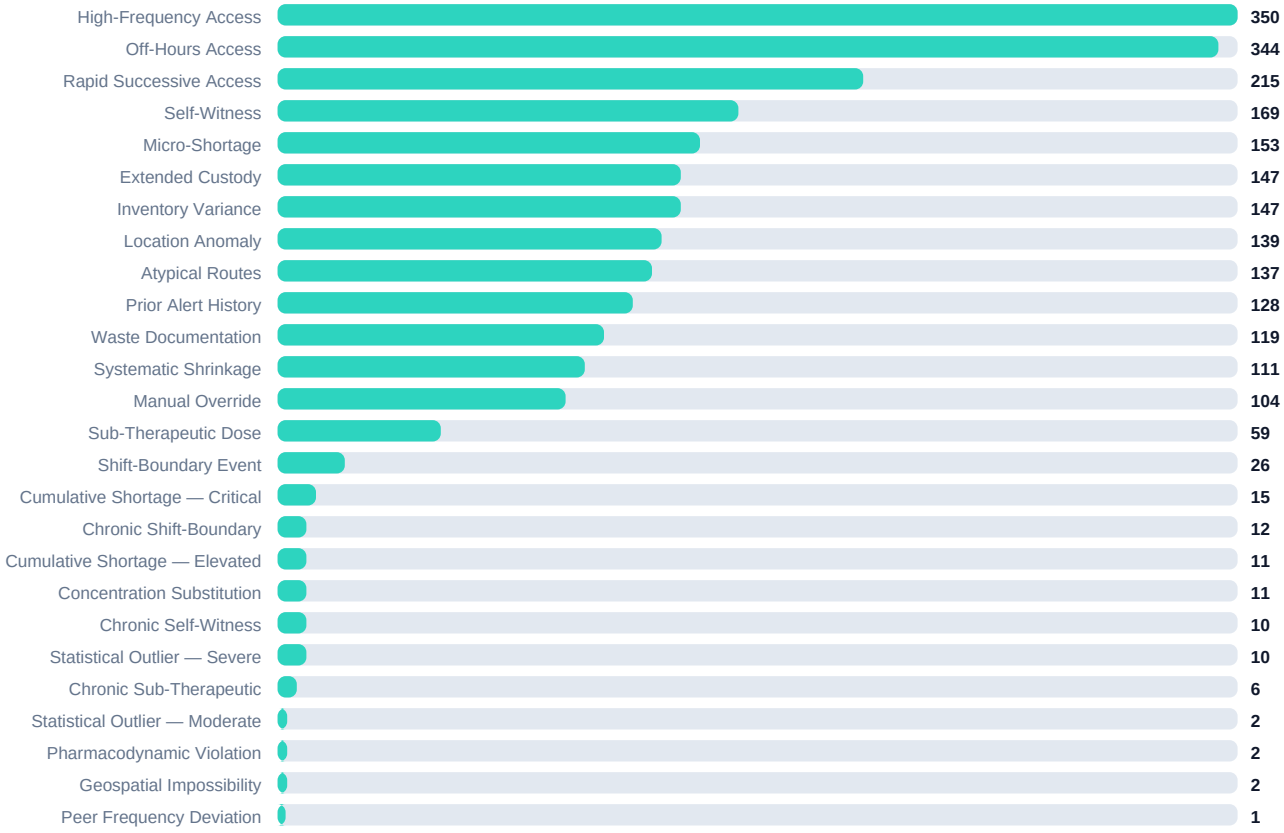
The scoring model's four risk levels (low, medium, high, critical) and escalation rules are validated independently. Escalator conditions are tested to confirm correct floor behavior.

> *"The engine doesn't just detect diversion — it validates itself against 1,004 scenarios every time we ship. When a new pattern is added, the prior cases keep it honest."*
>
> — NarcTrack Engineering

TEST COVERAGE

Every detector, by the numbers.

Pattern detectors sorted by times exercised across the full validation suite. Each was verified to fire correctly and to stay silent when it should.



ALL 63 TEST CATEGORIES — 100% PASS RATE

Every category from boundary conditions to real-world compound scenarios passed without exception on the current engine build.

Access 14/14	Baseline 2/2	Behavioral 20/20
Boundary — Cumulative Shortage 13/13	Boundary — Custody 16/16	Boundary — Dose Variance 12/12
Boundary — GPS 17/17	Boundary — High Frequency 10/10	Boundary — Off-Shift 13/13
Boundary — Prior Alerts 9/9	Boundary — Rapid Access 15/15	Boundary — Self-Witness 8/8
Boundary — Shift Boundary Rate 10/10	Boundary — Sub-Therapeutic 9/9	Clean — All Drugs 9/9
Clean — High Usage 1/1	Clean — Interval 6/6	Clean — Inventory 3/3
Clean — New Provider 1/1	Clean — Shift Config 5/5	Clean — Witness 3/3
Combo — 2-Pattern 66/66	Combo — 3-Pattern 100/100	Combo — 4-Pattern 60/60
Combo — 5-Pattern 100/100	Combo — 6-Pattern 100/100	Concentration 10/10

Concentration — Drug-Specific	3/3	Dosing — Fentanyl Sweep	48/48	Dosing — Morphine Sweep	15/15
Edge — Empty	2/2	Edge — Extreme	5/5	Edge — Missing	2/2
Edge — Multi-Drug	3/3	Edge — Par Level	2/2	Edge — Patient Weight	10/10
Edge — Time	1/1	Edge — Zeros	1/1	Escalator — 1 High + 3 Total	1/1
Escalator — 2 High, 2 Cat	9/9	Escalator — Additional	3/3	Escalator — Baseline	2/2
Escalator — High	2/2	Escalator — Medium	2/2	Escalator — No Escalation	2/2
Escalator — Single Isolation	12/12	Geographic	5/5	Inventory	11/11
Multi-Drug Accumulation	10/10	Per-Drug — Clean	9/9	Per-Drug — Dose Variance	9/9
Per-Drug — Missing Waste	9/9	Per-Drug — Non-Controlled	5/5	Per-Drug — Outlier	9/9
Per-Drug — Self-Witness	9/9	Per-Drug — Shrinkage	9/9	Real-World Scenarios	10/10
Real-World — Drug-Specific	4/4	Real-World — Shift Boundary	7/7	Risk Levels	1/1
Single Pattern — Custody	14/14	Single Pattern — GPS	14/14	Sweep — Custody	14/14
Sweep — Dose Variance	15/15	Sweep — Frequency	13/13	Sweep — GPS	13/13
Sweep — Prior Alerts	9/9	Time — Frequency Sweep	24/24	Time — Rapid Access Sweep	24/24

Ready to see it in action?

The validation report is one part of the story. See how the diversion engine performs against your agency's real workflows.

narctrack.io/validation

Live demo: demo.narctrack.io

Get in touch: hello@narctrack.io

Engine Version	Diversion Engine v2.0
Validation Date	March 15, 2026
Total Test Cases	1,004
Test Categories	63
Pattern Detectors	26
Pass Rate	100% (zero failures, zero regressions)
Produced by	NarcTrack — Veritas Technology Solutions