



CARELYTICS

Technical and Operational Overview

EMS-Hospital Data Exchange | Encounter/Incident Matching | Managed Services | Analytics

1. Product Overview

Carelytics is an interoperability platform that connects EMS agencies and hospital health systems for automated, bidirectional exchange of patient care data. For each customer implementation, Carelytics receives EMS data from the configured repository and approved source connections, which may include participating state systems, direct agency connections, or other approved EMS data sources.

Carelytics does not replace existing ePCR systems or hospital EHRs. It operates as an integration layer between them: matching patient records across systems, and returning outcomes back to EMS.

Core Capabilities

- EMS-Hospital Data Exchange: automated, secure delivery of ePCR data into the hospital EHR upon ePCR submission
- ePCR vendor-agnostic ingestion and EHR-agnostic delivery using established healthcare standards
- Encounter/Incident Matching: automated linking of EMS records to the correct hospital encounter
- Managed exception process for records requiring manual review
- Outcome Data Return: structured return of discharge diagnoses, procedures, and disposition data to the originating EMS agency where supported
- Analytics and Market Intelligence: dashboards for EMS volume, patient flow, referral patterns, and market share
- Managed Services: ongoing operational support for integration management and reporting needs

2. Architecture and Data Flow

Key Components

- Load-balanced routing across application servers
- Application services host the core platform, matching engine, and integration layer
- ePCR Repository: ImageTrend's EMS data store, the source of inbound ePCR data
- Azure-hosted SQL data engine for primary data persistence



- ETL pipeline feeding the data warehouse and analytical reporting layer
- Reporting and analytics layer providing dashboards and Market Intelligence

Architecture Summary

- EMS agencies submit ePCR data in NEMSIS v3 format to the ImageTrend ePCR Repository via webservice or other approved source connections configured for the customer implementation
- Hospital EHRs generate HL7 ADT messages on admission and discharge, routed to Carelytics through the hospital's existing interface engine
- Carelytics ingests both data streams, and runs the encounter matching engine
- Matched ePCR records are delivered to the hospital EHR via the existing interface engine
- On patient discharge, a second ADT event triggers outcome data capture and return to EMS
- ePCR data and linked EHR outcomes are posted for Market Intelligence analytics

Supported Standards and Protocols

Standard / Protocol	Role in Carelytics	Notes
NEMSIS v3	EMS ePCR data format	Required for all inbound EMS records
NEMSIS Webservice	ePCR delivery to repository	Used for EMS repository submission where applicable.
HL7 v2.x ADT	Hospital admission and discharge events	Supported ADT events are confirmed during implementation; commonly evaluated events include A01, A03, A06, and A08.
Embedded PDF	ePCR delivery format into hospital EHR	Generated by Carelytics from NEMSIS source data
VPN (TCP/IP)	Secure hospital-to-platform connectivity	Standard connection method for hospital integration
Direct Messaging	Alternative transport where applicable	Configured during implementation
OIDC	Customer identity provider integration	Supported where configured and confirmed during implementation



3. Integration and Data Sources

Carelytics is ePCR vendor-agnostic and EHR-agnostic. It connects to existing hospital infrastructure through established integration standards without replacing core clinical or operational systems.

Hospital-Side Integration

- Carelytics integrates with the hospital's existing interface engine
- HL7 ADT A01 (admission/registration) and A03 (discharge) messages are routed from the EHR to Carelytics through the interface engine
- Matched ePCR records are returned to the EHR typically a HL7 message with an embedded PDF through the same engine
- Epic, Cerner, Meditech, and other major EHR platforms are supported; field mapping is defined and validated during implementation

EMS-Side Data Sources

- Operational EMS data enters Carelytics through the EMS repository and source connections configured for the customer implementation, which may include participating state systems, direct agency connections, or other approved EMS data sources
- Agencies not part of a connected state system can be onboarded through direct agency agreements
- EMS coverage is assessed during implementation scoping

Data Availability and Variability

Data availability depends on the EMS source connections, hospital ADT routing, and data use permissions configured for the customer implementation. Key limitations related to data completeness, submission timing, coverage, analytics permissions, and third-party vendor dependencies are summarized in Section 12.

4. Encounter/Incident Matching

Encounter/Incident Matching links EMS records to the appropriate hospital encounter using available patient, incident, and encounter data.

Automated Matching

The matching engine runs automatically when an ePCR record and a corresponding hospital ADT registration message are both available. The algorithm applies a combination of deterministic, referential, and weighted probabilistic logic across available data elements:

- Patient demographics: legal name, date of birth, gender
- Known identifiers: MRN when present in the EMS record, visit or encounter number
- Operational context: transport destination, incident date and time, EMS unit identifiers
- Probabilistic scoring: weighted comparison across available fields when exact matches are not possible



When the algorithm identifies a likely match that meets configured matching criteria, records are linked and the ePCR is delivered to the EHR without human intervention.

Manual Review and Exception Queue

Records that cannot be matched automatically are placed in an exception queue. This occurs when confidence falls below threshold, required data elements are absent, or conflicting signals exist.

- Carelytics UI will provide a dedicated workspace where users can review and manually confirm potential patient record matches that were not automatically matched during the system's automated matching process. This interface will allow users to evaluate match candidates, compare relevant record details, and confirm the correct match to improve overall data accuracy and patient record linkage.
- Records that cannot be matched are retained; they are not discarded
- Customers have visibility into exception queue volume and resolution status through Carelytics reporting

Matching Accuracy and Known Limitations

- **Data completeness:** Matching quality is directly tied to the completeness of both the EMS record and the hospital ADT. Missing or inconsistent demographics reduce match confidence.
- **Timing sensitivity:** If an ADT message is not yet available when an ePCR arrives, matching is deferred until both records are present. Late ADT generation or delayed ePCR submission creates a gap between patient arrival and ePCR availability in the EHR.
- **Name and DOB variations:** Informal names, nicknames, or transcription differences between EMS documentation and hospital registration reduce confidence scores.
- **Probabilistic matching:** Not all matches are exact. Some are based on weighted scoring across partial signals. The algorithm is designed to minimize false positives, but probabilistic matching carries inherent uncertainty.
- **MRN availability:** Most EMS agencies do not have access to hospital MRNs at the time of documentation. The engine is designed to function without MRN but performs with greater confidence when it is present.

Match Validation and Patient Safety Controls

Carelytics is designed to reduce incorrect encounter matching through deterministic, referential, and probabilistic matching logic. Records that do not meet configured matching criteria are not automatically linked and are routed to an exception workflow for review. Customers should define appropriate operational review processes for workflows where incorrect matching could affect clinical operations, HIM processes, or downstream reporting.

5. Encounter/Incident Matching Review: Carelytics UI

The Carelytics UI provides hospital users and ImageTrend teams visibility into matching activity, exception queues, and resolution workflows as enabled for the customer environment.



Core Functionality

- Encounter Matching Review: a list of EMS and EHR records that could not be automatically matched, presented with available patient demographics, transport details, and incident data
- Candidate review: for each exception, the Carelytics UI presents the most likely hospital encounter candidates ranked by confidence score, along with the data elements that drove each score
- Match confirmation and rejection: users review candidates and confirm, reject, or defer each record according to the configured customer workflow.
- Audit visibility: authorized users can review match history, review activity, and resolution actions where supported in the configured encounter matching workflow.

Access and Roles

- Hospital users: designated staff (HIM, clinical informatics, or ED operations) log in with role-based access scoped to their facility or health system.
- ImageTrend Managed Services: access to the same interface for support, exception escalation, and monitoring.
- Authentication options are confirmed during implementation and security review based on supported customer identity provider configuration.
- Access is partitioned by health system; users cannot view records from other organizations.

Relationship to Managed Services

The Carelytics UI supports customer ownership of exception review once enabled and users are trained. ImageTrend support continues according to the agreed Managed Services scope.

6. Matching Operations and Managed Services

Carelytics includes a Managed Services function providing ongoing operational support for integration management, issue resolution, and reporting.

Interim Manual Matching Model

ImageTrend Managed Services may support matching exception operations during implementation or transition periods according to the agreed customer scope. As customer-facing review workflows are enabled and users are trained, routine exception review will transition to the customer organization. Specific responsibilities, escalation paths, and transition timing are documented in the customer implementation and Managed Services scope.

What Managed Services Includes

- Active monitoring of data flows between EMS and hospital systems, with alerting when message volumes fall outside expected ranges or integrations degrade
- Operational monitoring and escalation support



- Integration configuration support: adjustments to message routing, field mappings, and interface behavior as the environment changes
- Participation in joint governance, including scheduled performance reviews with the customer

What Managed Services Does Not Include

- Clinical review or validation of matched patient records: responsibility of hospital clinical or HIM staff
- EHR workflow configuration: how ePCR data surfaces in clinical workflows is managed by the hospital
- Interface engine management on the hospital side
- EMS agency onboarding outside the EMS source connections or agency agreements included in the agreed customer implementation scope
- Routine manual matching or clinical validation unless explicitly included in the agreed customer scope

7. Customer and Vendor Responsibilities

The table below summarizes the shared operating model. ImageTrend operates the Carelytics platform and supports the configured technical implementation. The customer organization owns hospital readiness and EMS stakeholder engagement, including coordination with participating agencies to support timely, accurate, and complete ePCR documentation and submission. ImageTrend does not direct EMS documentation practices or manage agency engagement outside the agreed implementation scope.

ImageTrend / Carelytics	Customer / Hospital Organization
Configure and manage Carelytics platform and cloud infrastructure	Provide hospital IT, interface, security, HIM, and operational owners for implementation and go-live support
Provide platform ingestion, monitoring, and escalation support for EMS data received by Carelytics	Engage participating EMS agencies and support timely, accurate, and complete ePCR documentation and submission
Operate Carelytics ingestion, processing, and monitoring of EMS data received through the ePCR Repository	Configure and maintain hospital-side interface engine routing, network access, and firewall rules
Operate the automated encounter/incident matching engine	Validate matched records and manage EHR workflows for ePCR data
Support matching operations during implementation and transition periods according to agreed scope	Designate contacts for match review, validation, and escalation workflows
Provide operational visibility and support through the Carelytics UI and Managed Services scope	Own routine exception review once the Carelytics UI is enabled and users are trained



ImageTrend / Carelytics	Customer / Hospital Organization
Transform NEMSIS ePCR data to pdf for EHR delivery	Accept and ingest ePCR data in the EHR per agreed method
Monitor platform data flows and alert on anomalies	Notify ImageTrend of EHR changes that affect ADT message format or volume
Return outcome data to EMS following discharge ADT receipt	Ensure ADT A03 discharge messages are routed to Carelytics
Provide Managed Services support per defined scope	Participate in governance reviews and respond to exception escalations
Maintain HIPAA compliance and security controls	Coordinate EMS agency participation, source connections, and customer-specific data access approvals required for the implementation

8. End-to-End Workflow

The sections below describe the complete data lifecycle through Carelytics, from EMS patient contact through outcome return and analytics. Dependencies and potential delay points are noted.

Phase 1: Pre-Hospital

- EMS crew documents the encounter in the ePCR system using NEMSIS v3 fields
- ePCR is submitted to the ImageTrend EPCR Repository upon call close
- **Dependency:** ePCR availability depends on agency submission timing

Phase 2: Hospital Arrival and Registration

- Patient arrives and is registered in the EHR
- EHR generates HL7 ADT A01 (admission/registration)
- Hospital interface engine routes the ADT to Carelytics
- **Dependency:** ADT generation timing affects when matching can begin

Phase 3: Matching and ePCR Delivery

- Carelytics receives the ADT and queries the ePCR Repository for a corresponding ePCR
- If both records are available, the matching logics runs and produces a confidence score
- High-confidence matches: ePCR is delivered to the EHR automatically
- Low-confidence or unmatched records: placed in the exception queue for Managed Services review
- **Dependency:** Matching runs once both the ADT and ePCR are available.

Phase 4: Discharge and Outcome Return

- Patient discharged; EHR generates HL7 ADT A03
- Carelytics ingests the discharge ADT and captures: diagnoses, procedures, ED and hospital disposition, admission and discharge dates
- Outcome data is returned to the originating ePCR system where integration is supported



- **Dependency:** Structured outcome write-back requires ePCR vendor support; otherwise outcomes are accessible through the Carelytics UI

Phase 5: Analytics and Reporting

- Matched encounter data is available in Carelytics dashboards and Market Intelligence
- Health system users can view EMS transport volume, patient flow, referral patterns, and matching performance
- Aggregated, de-identified data is available for benchmarking and cross-market analysis where permitted by state DUAs

9. Security and Compliance

Detailed security documentation is provided during procurement and implementation activities, including security questionnaires, architecture documentation, business continuity information, disaster recovery documentation, and Business Associate Agreement materials.

Data Retention and Lifecycle Management

Carelytics stores and processes patient information necessary to support data exchange, encounter matching, outcome return, analytics, auditability, and operational support. Data retention, archival, and deletion practices are governed by applicable contractual, regulatory, and operational requirements.

Infrastructure and Hosting

Carelytics is hosted in Microsoft Azure and AWS cloud infrastructure. Availability, redundancy, backup, and disaster recovery capabilities are managed as part of the Carelytics operating environment and documented during security and implementation review.

Identity and Access Management

Access to Carelytics is controlled through role-based permissions and organizational data partitioning. Authentication may be integrated with supported customer identity providers through SSO where configured.

Compliance Certifications

- HIPAA: controls and processes are designed to support compliant data management and transmission.
- SOC 2 Type II: evidence is provided through security review documentation where applicable.

Data Protection

- AES-256 encryption at rest
- TLS encryption in transit
- Role-based access control; users access only their own patient data with no cross-agency visibility
- Audit logging is maintained for platform access and data processing events according to Carelytics logging controls



- Regular vulnerability scans and patch management process
- Disaster recovery plan in place

Integration Security

- Hospital connections use VPN (TCP/IP), Direct Messaging, or REST APIs with authentication controls
- Network connectivity requirements are documented during implementation scoping
- HL7 message retention is governed by processing integrity, audit, and operational support requirements

Data Use and Access Governance

- Business Associate Agreements (BAA) are executed with all health system customers
- Data use agreements may govern aggregated or de-identified EMS data used for analytics, benchmarking, Market Intelligence, or other secondary use cases where applicable
- De-identified data used for benchmarking and Market Intelligence is processed per applicable de-identification standards
- EMS agency data access is partitioned by agency; no cross-agency data exposure
- Operational Carelytics data access is limited to records received through the repository and source connections configured for the customer implementation

10. Implementation Overview

Implementation involves configuring integrations between the hospital interface engine and Carelytics, validating data flows, calibrating the matching engine for the customer environment, and onboarding users. Effort varies by hospital environment complexity and EMS agency scope.

Implementation Phases

- **Phase 1 - Discovery and Scoping:** Review of hospital EHR, interface engine, and EMS relationships; ADT message format identification and field mapping; EMS coverage assessment using Image Trend's coverage metric
- **Phase 2 - Integration Configuration:** HL7 ADT ingestion setup; ePCR delivery configuration; network connectivity and firewall rule establishment
- **Phase 3 - Pilot:** Activation with a subset of EMS agencies and a single facility; validation of matching rates, data completeness, and field mapping accuracy; edge case resolution before broader rollout
- **Phase 4 - Scale and Go-Live:** Expansion to additional hospitals and agencies; Managed Services monitoring activation; user training on dashboards and exception workflows
- **Phase 5 - Steady State:** Ongoing governance and Managed Services support; performance reporting; continued matching improvement

What Hospital IT Teams Should Expect

- Active involvement in interface engine configuration and testing during Phases 1 through 3
- An IT lead available to manage ADT message routing, field mapping validation, and network configuration



- Coordination with the EHR vendor if ePCR ingest requires workflow configuration in the EHR
- Firewall and network changes to permit secure data exchange with Carelytics cloud infrastructure
- Participation in UAT for matched record delivery and outcome return

Customer Readiness Checklist

- Identify hospital IT, interface engine, security, HIM, and operational owners for implementation and go-live support.
- Confirm hospital interface engine capability to route required ADT messages to Carelytics.
- Confirm ePCR ingest approach and where documents will appear in the EHR workflow.
- Provide network, VPN, firewall, and endpoint details required for secure connectivity.
- Confirm required registration and encounter data elements are available in the ADT feed.
- Identify the customer team responsible for reviewing matching exceptions and escalating suspected incorrect matches.
- Confirm participating EMS agency coverage, implementation-specific source connections, and any direct agency agreement needs.
- Confirm security review requirements, including BAA, questionnaire, architecture, continuity, and disaster recovery documentation requests.
- Define UAT success criteria for ADT ingestion, ePCR delivery, outcome return, user access, and reporting visibility.

Effort and Timeline

Implementation timelines vary based on hospital interface readiness, security review requirements, EHR workflow configuration, and EMS source connection scope. Specific timelines are confirmed during implementation planning.

Required Hospital Data Elements

Encounter matching performance depends on the availability and quality of hospital registration and encounter data. Required and recommended data elements are validated during implementation.

11. Key Limitations and Considerations

The following reflect the inherent characteristics of interoperability across healthcare and EMS systems.

Data Dependency

- Match quality, analytics coverage, and outcome return are proportional to the quality and completeness of inbound EMS and hospital data.
- Markets with lower agency submission rates or incomplete NEMSIS fields will have reduced match rates and analytics coverage. Coverage is surfaced during scoping using ImageTrend's coverage metric.



- Hospitals generating ADT messages with significant delay relative to clinical workflows will experience a corresponding gap between patient arrival and ePCR availability in the EHR.
- EMS documentation quality, completeness, and submission timing vary across agencies and jurisdictions. Carelytics relies on data received from participating EMS agencies and does not control agency documentation workflows, operational processes, or compliance with state-specific documentation requirements. Delays or inaccuracies in source documentation may impact matching, outcome return, and analytics availability.

Probabilistic Matching

- The matching algorithm produces confidence scores, not guaranteed exact matches. Some automatically matched records may be incorrect, and some correct matches may fall to the exception queue depending on data completeness.
- Hospitals should establish a HIM or clinical review process for high-sensitivity workflows (trauma activations, STEMI, stroke) where data accuracy is operationally critical.
- Matching accuracy improves over time within a deployment as exception queue feedback and customer-reported issues inform algorithm tuning.

State and Regulatory Variability

- Aggregated analytics and Market Intelligence use may be governed by state-level data use permissions that vary by jurisdiction. Coverage and restrictions are assessed during scoping.
- In markets without broad ImageTrend state system coverage, representative EMS data requires direct agency agreements. The UEC metric provides a baseline for evaluating coverage before deployment.
- Carelytics cannot provide access to EMS data that is not received through the repository or source connections configured for the customer implementation.

Third-Party Vendor Dependencies

- Outcome write-back to agency ePCR systems requires integration support from the ePCR vendor. Not all vendors support structured outcome return. Where this applies, outcomes are accessible through the Carelytics UI.
- EHR field mapping for ePCR document ingest may require coordination with the EHR vendor and depends on that vendor's interface capabilities.

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Appendix A. Glossary of Terms and Abbreviations

The following terms and abbreviations are used throughout this document.

Term / Abbreviation	Definition
ADT	Admission, Discharge, Transfer message. A standard HL7 message type generated by the hospital EHR to communicate patient registration, movement, and discharge events.
ADT A01	Admission or registration event message used to indicate that a patient encounter has been created in the hospital EHR.
ADT A03	Discharge event message used to indicate that a patient encounter has ended and discharge data may be available.
API	Application Programming Interface. A secure method for systems to exchange data programmatically.
BAA	Business Associate Agreement. A HIPAA-required agreement governing how protected health information is handled by a vendor or partner.
DOB	Date of birth.
DUA	Data Use Agreement. An agreement that governs how data may be accessed, used, shared, or analyzed.
EHR	Electronic Health Record. The hospital system of record for patient registration, clinical documentation, orders, results, and encounter history.
EMS	Emergency Medical Services. Pre-hospital emergency response agencies and providers.
EPCR	Electronic Patient Care Report. The EMS care record created by an EMS agency during or after an incident.
ETL	Extract, Transform, Load. A data processing workflow that moves data from source systems into a reporting or analytics environment.
HA	High availability. A system design approach intended to reduce downtime and maintain service continuity.
HIPAA	Health Insurance Portability and Accountability Act. U.S. federal law governing the privacy and security of protected health information.
HIM	Health Information Management. Hospital function responsible for health records, coding, release of information, and related data integrity workflows.
HITECH	Health Information Technology for Economic and Clinical Health Act, promotes the adoption of EHRs, strengthens HIPAA privacy and security rules, and establishes breach notification requirements



Term / Abbreviation	Definition
HL7	Health Level Seven. A set of healthcare data exchange standards used by hospitals, EHRs, and interface engines.
MARKET INTELLIGENCE	Carelytics analytics capability that provides visibility into EMS volume, patient flow, referral patterns, market share, and related operational trends where data use is permitted.
MDM^T02	A standard HL7 message that is commonly used to send an ePCR PDF from EMS to a hospital EHR after patient care documentation is completed. The message includes document metadata (TXA) and the document content, often an embedded PDF, in the OBX segment.
MRN	Medical Record Number. A patient identifier assigned by a hospital or health system.
NEMSIS	National Emergency Medical Services Information System. The national EMS data standard used for ePCR data submission and reporting.
NEMSIS WEBSERVICE	The method of data exchange between State Elite Sites and the Carelytics Repository along with 3rd Party Vendors.
NIST	National Institute of Standards and Technology. U.S. agency that publishes cybersecurity and technology standards and guidance.
OIDC	OpenID Connect. An authentication protocol used for single sign-on and identity verification.
ORU^R01	A standard HL7 message that is commonly used to send an ePCR PDF from EMS to a hospital EHR after patient care documentation is completed. The message includes an embedded PDF, in the OBX segment.
REST API	Representational State Transfer API. A common web-based method for systems to exchange data securely.
SOC 2 TYPE II	Independent audit report evaluating security, availability, and related controls over a defined operating period.
SSO	Single sign-on. Authentication method allowing users to access Carelytics through an existing organizational identity provider.
TCP/IP	Transmission Control Protocol / Internet Protocol. Core network communication protocol used for system connectivity.
TLS	Transport Layer Security. Encryption protocol used to protect data in transit.
UAT	User Acceptance Testing. Customer validation that configured workflows and data flows operate as expected before go-live.



Term / Abbreviation	Definition
UEC	Underlying Event Coverage. ImageTrend metric comparing EMS records received to estimated EMS events in a region to assess data coverage.
UI	User interface. The screen-based Carelytics experience used by customer and ImageTrend users.
VPN	Virtual Private Network. Secure network connection used to exchange data between hospital systems and Carelytics.

