Just What the Doctor Ordered: Innovative Use Cases in Healthcare

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splunk>

Agenda

1. Motivation and Background: Healthcare
2. Data Integration and Enrichment
3. Data Exploration
4. Data Product Development and Application Integration
5. Business Value Summary

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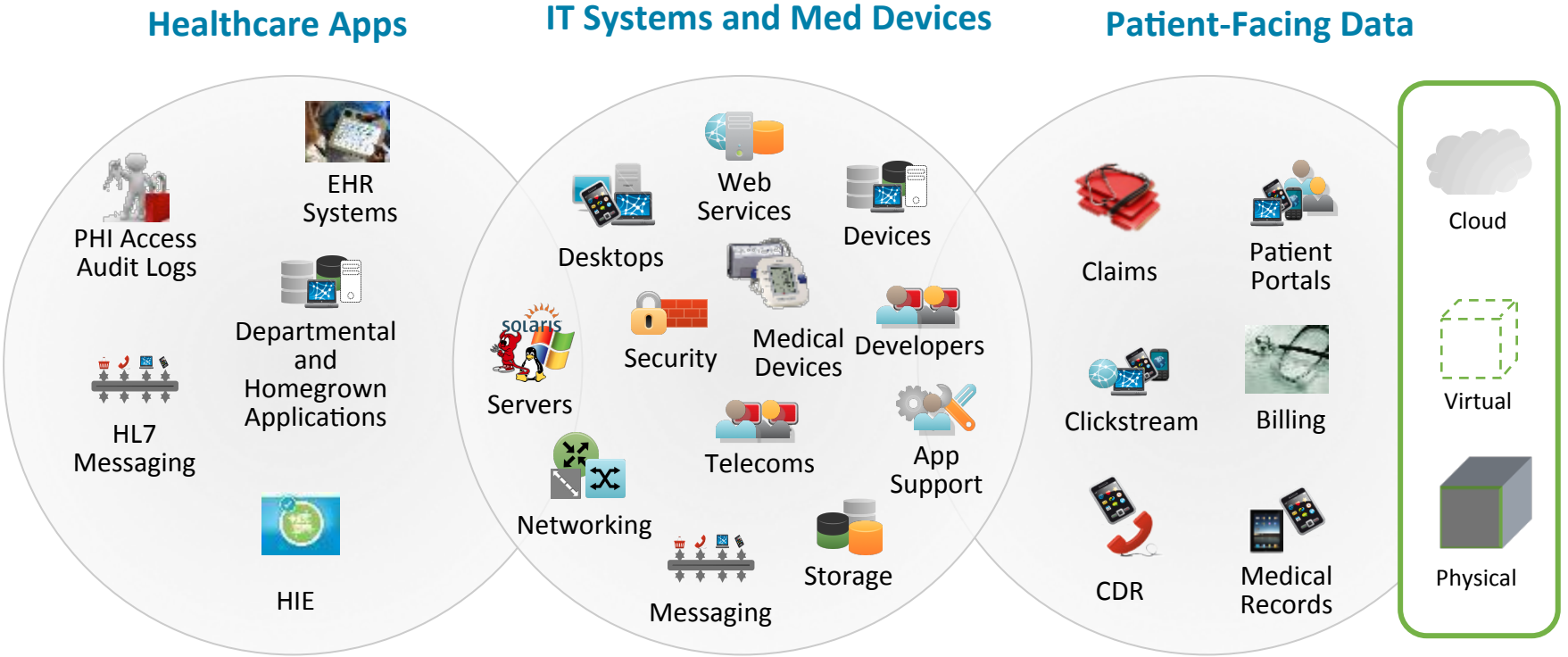
Healthcare Data is Time Oriented and Diverse



Domains of Data Diversity in Health Data

Subjects
Persons, Sensors, Actuators, Mobile Devices

System and Locations
Home, Hospital, ER, Nursing Homes

Information Users
Clinical, Family, Patient

Ownership and Management

Barriers for Business Value

Ability to easily ingest diverse data sets

Flexibility to capture data

Restricted system access

Quickly getting value from data

Splunk Capabilities for Healthcare Solutions

Schema-less approach/ late binding to schema

Dynamic "normalization" of data

Agile analytics and reporting

Scalable search and analytics

Seamless operational integration

Specific Healthcare Operations Management Problems

Capacity Planning (human resources, machines) in Hospitals
Identifying bottlenecks in patient flow in hospitals and emergency care
Discovering clinical pathways for condition X
Analyzing clinical pathway adherence
Optimization for improved availability of medical devices
Provider scheduling
Finding gaps, redundancies, and conflicts in care coordination
Identifying fraud, waste, and abuse

Abstraction of Machine Data - Modeling


```
{
  "resourceType": "Patient",
  "identifier": [
    {
      "system": "urn:oid:1.2.36.146.595.217.0.1",
      "value": "12345",
      "period": {
        "start": "2001-05-06"
      }
    }
  ],
  "name": [
    {
      "use": "official",
      "family": ["Lucus"],
      "given": ["Stephaney"]
    },
  ],
  "gender": {
    "coding": [
      {
        "system": "http://hl7.org/fhir/v3/AdministrativeGender",
        "code": "M",
        "display": "Male"
      }
    ]
  },
  "birthDate": "1974-12-25",
  "address": [
    {
      "use": "home",
      "line": ["534 Erewhon St"],
      "city": "PleasantVille",
      "state": "Vic",
      "zip": "3999"
    }
  ]
}
```


Patient

- identifier
- name
- telecom
- gender
- birthDate
- deceased
- address
- maritalStatus
- ....
- active

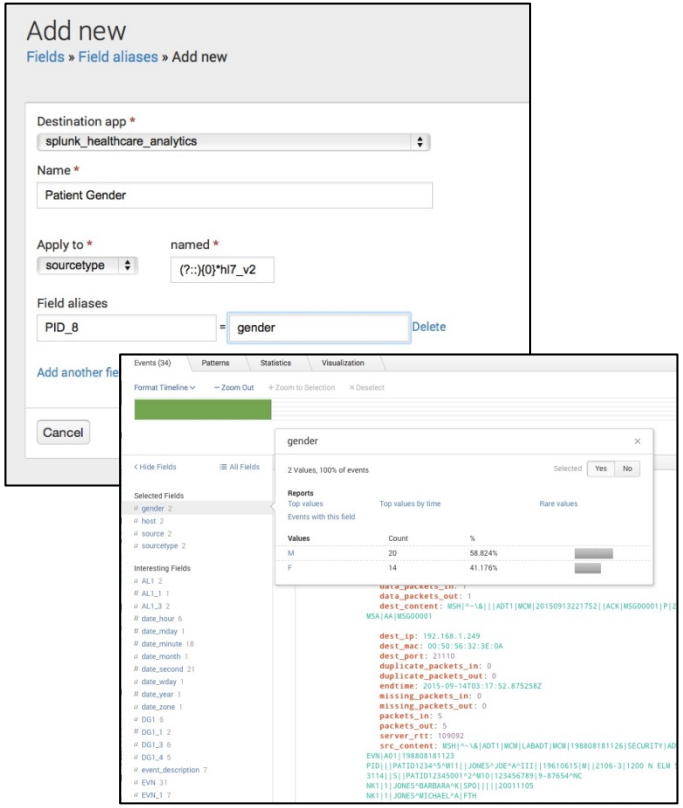

```
<recordTarget>
   <patientRole>
      <id extension="12345" root="PlaceholderOrganization" />
      <addr use="HP">
         <streetAddressLine>180 Fake Road</streetAddressLine>
         <city>Providence</city>
         <state>RI</state>
         <postalCode>02912</postalCode>
         <country>US</country>
      </addr>
      <telecom use="WP" value="tel:+1-401-867-7949" />
      <patient>
         <name>
            <given>Stephaney</given>
            <family>Lucus</family>
         </name>
        <administrativeGenderCode code="F"
codeSystem="2.16.840.1.113883.3.560.100.2" displayName="Male" />
```



```
MSH|^~\&|EPIC|MGH||MGH|20150324190937|OHEDSCRIBE|ADT^A08|
725467|T|2.3|||||||||
.....
PID|1||12345^^^EPI^MR||LUCUS^STEPHANEY||19751225|M|||
^^^^^US^P|||||||6100215419|999-99-9999||||||||||N||
.....
```

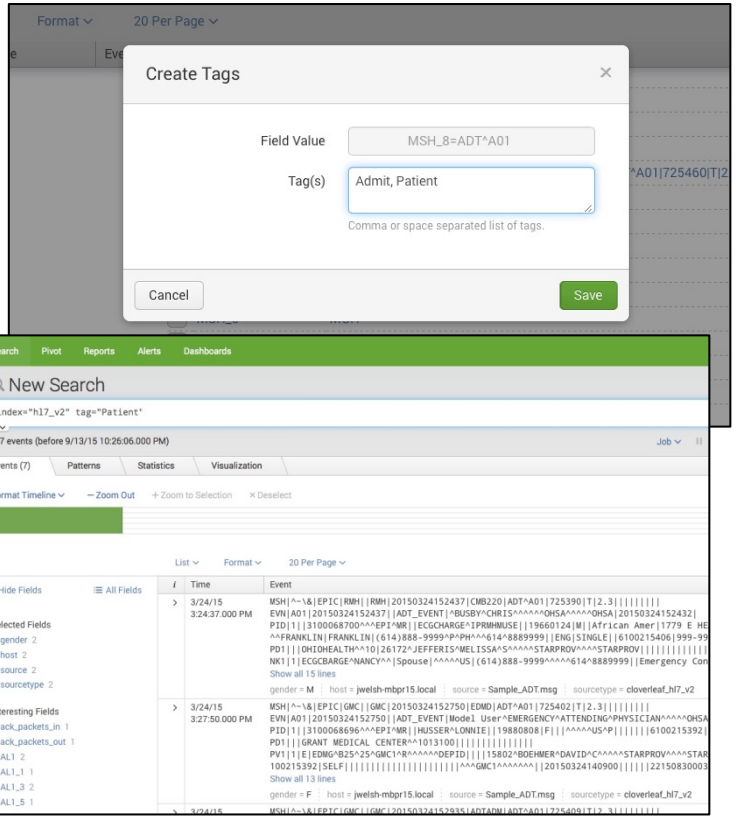

i	_time	ENROLID	DX1_DESC	AGE	NETPAY	PROC1	sourcetype	DX1
>	12/31/11 12:00:00.000 AM	29234305301	Vitamin D deficiency NOS	52	9.27	85025	outpatientmc	2689
>	12/31/11 12:00:00.000 AM	29234305301	Vitamin D deficiency NOS	52	30.76	84403	outpatientmc	2689

Dynamic “Normalization”



Patient

identifier
name
telecom
gender
birthDate
deceased
address
maritalStatus
....
active

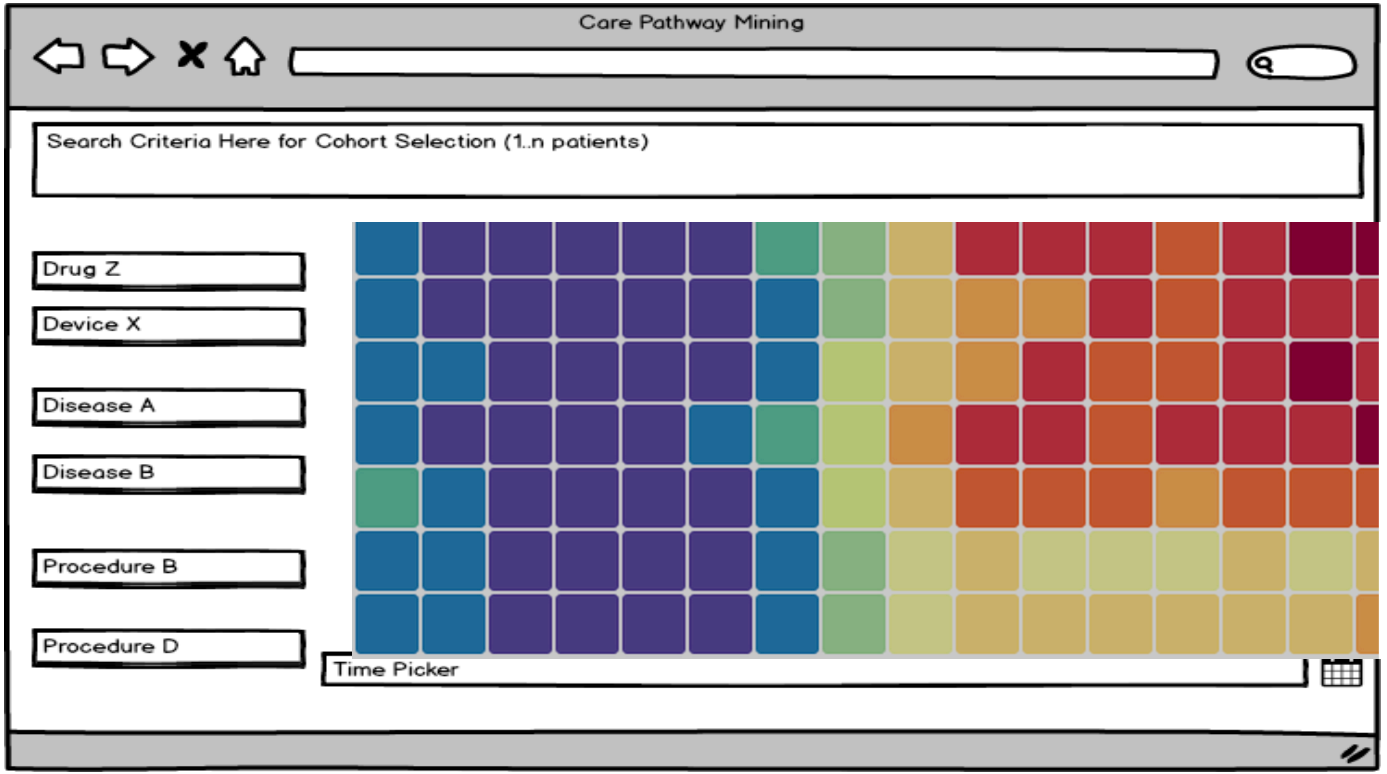


Statistics, Machine Learning, and Visualization

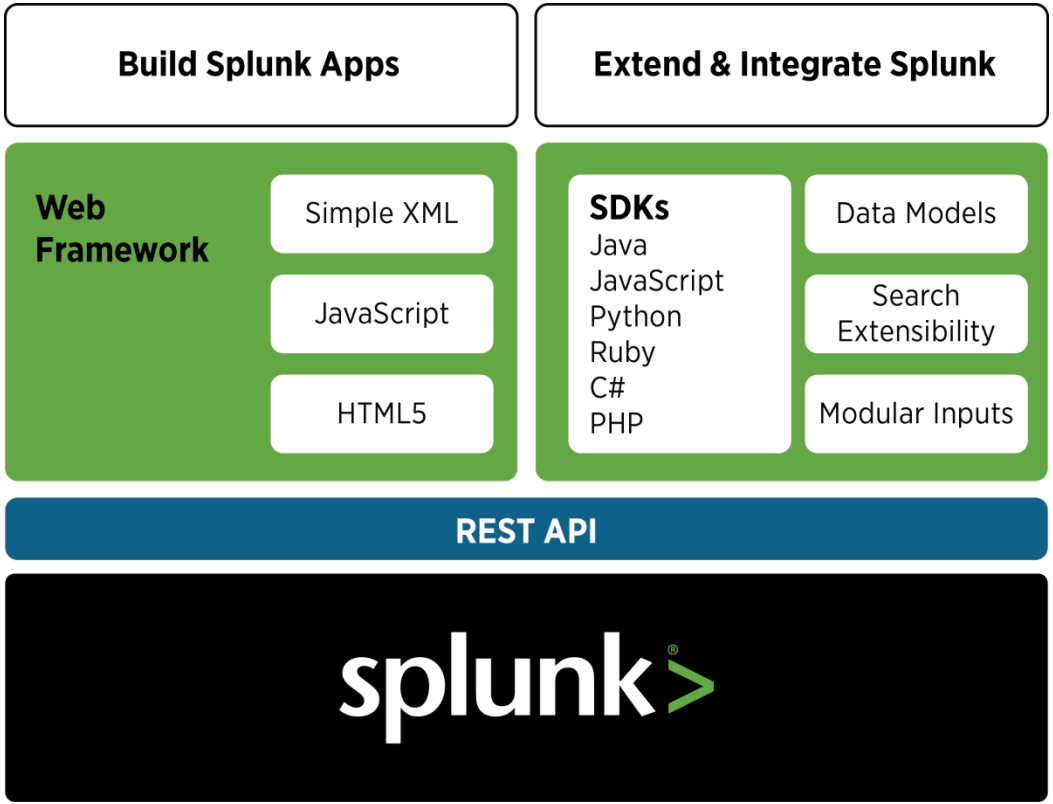
Examples of Machine Learning For Exploratory Data Analysis

Data Analysis Concept	ML Solution
Find common and/or rare events in your data	Clustering
Find anomalous events	Anomaly Detection
Find a relationship between pairs of fields by change in entropy (can knowing the value of a field help predict the value of another?)	Association Rule

See Millions at a Time and Visualize Process/Journey



Application Development Platform



Enable Interoperability

1

Standard terminology and models

(i.e., FHIR)

2

Data interoperability

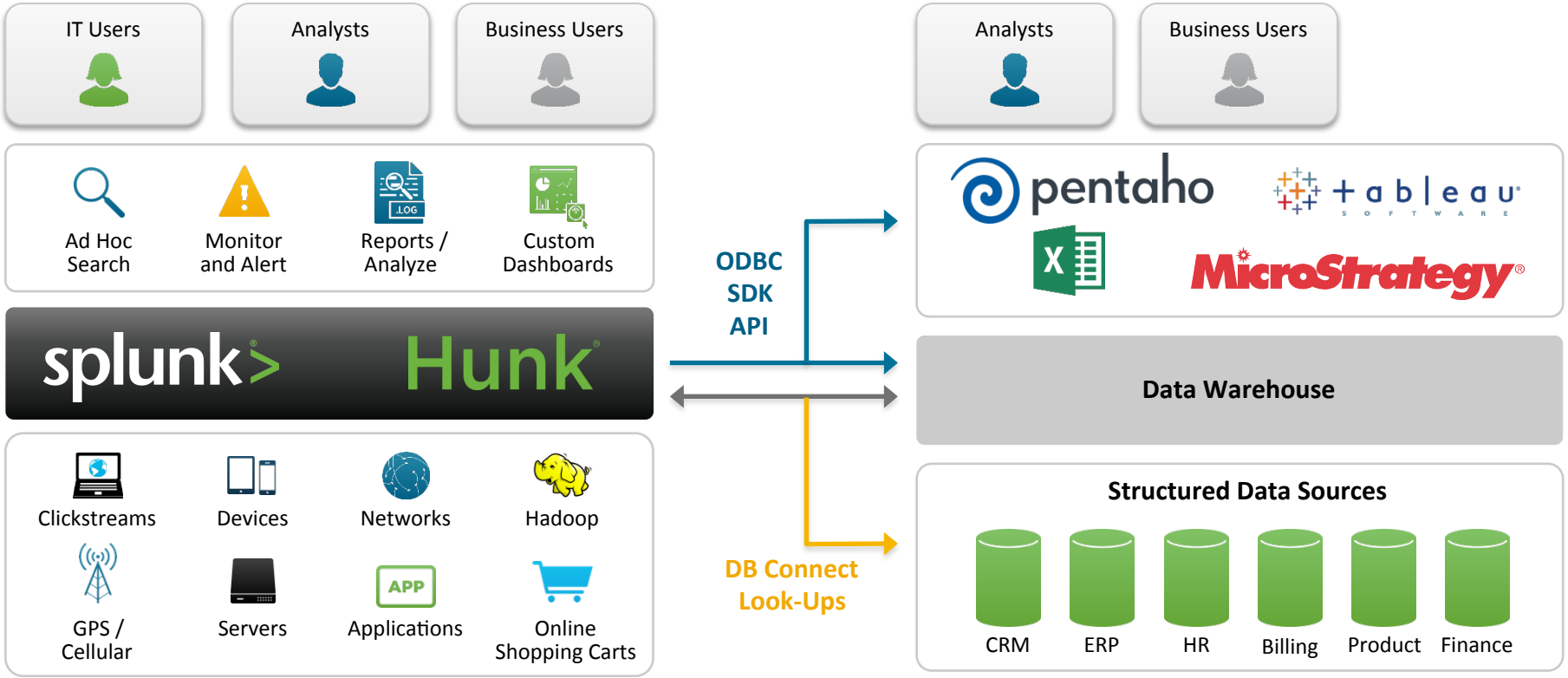
Platform capable of analytics on all types of data from diverse sources

3

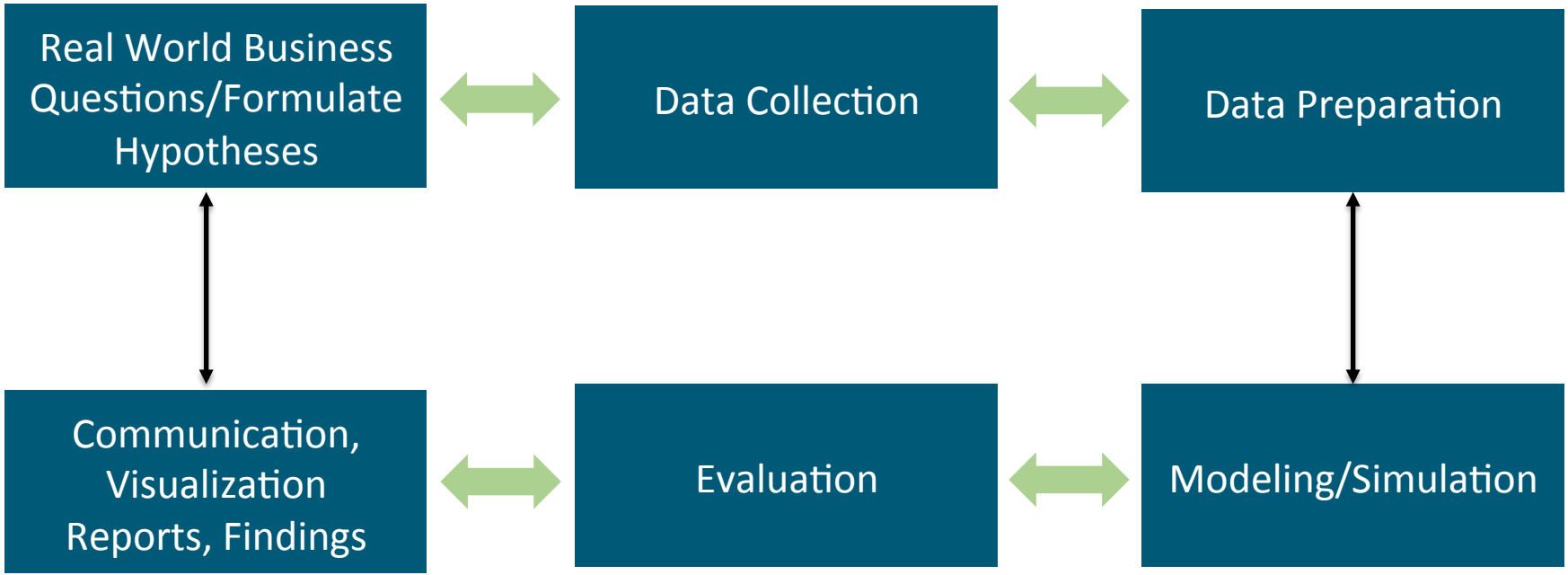
System interoperability

Platform capable of connecting to legacy and newer applications (REST API)

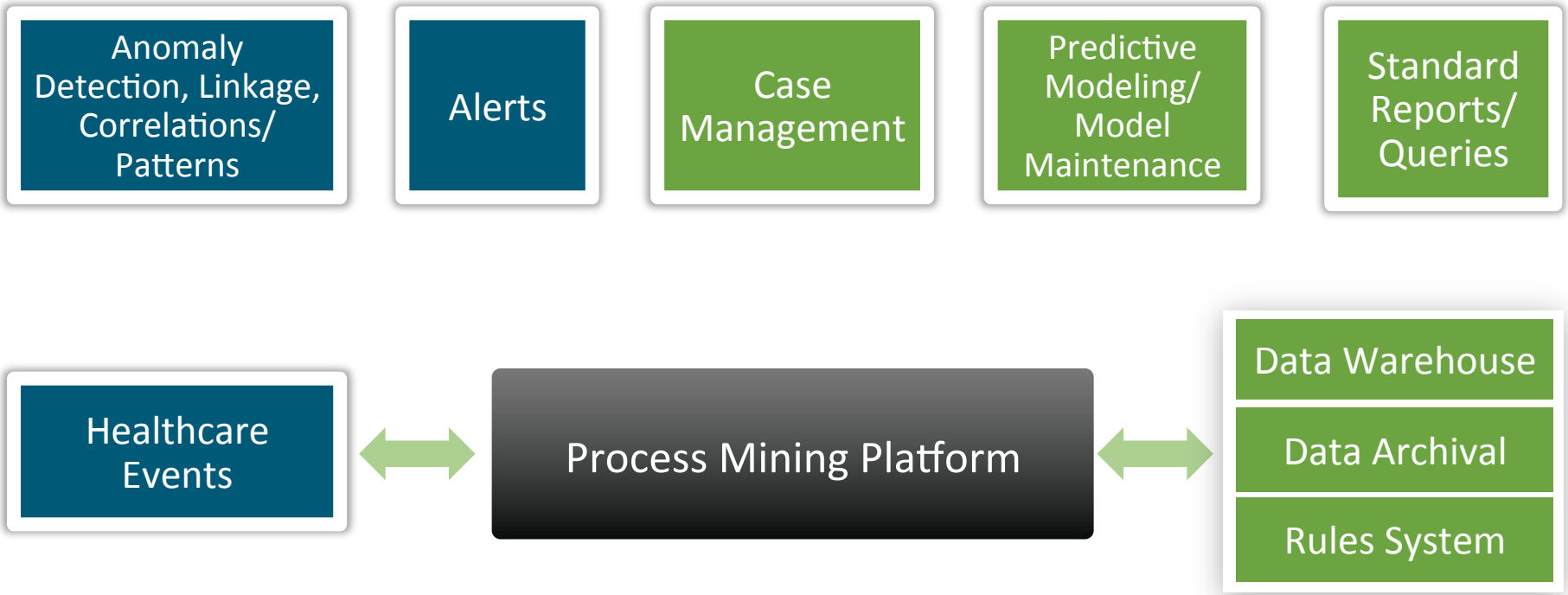
Ecosystem Integration



Post Mortem: Data Science Experiment Design and Execution



Pre Mortem: Real-Time Monitoring, Detection and Predictions



How is Splunk Different?

	Without Splunk	With Splunk
Data Collection	Manual extraction from discharge reports, simulate test data	Actual event data and event metadata (logs)
Data Types	Data must be structured in a pre-defined schema	Structured, semi-structured, un-structured data; no fixed schema needed for data access
Visualization Methods	Excel and schema-based BI tools	Augment with big data visualization and analytics techniques
Analytics Methods	Descriptive analysis (counting, etc.)	Augment with machine learning and relevant data visualizations
Usage in Operations	Monthly; once or twice a year	Near real time (hourly, daily, weekly)

Business Value of Splunk's Capabilities

1. **Save lives, better outcomes**
2. **Reduce project time and costs**
3. **Improve patient experience and engagement**

Other Healthcare Sessions

- Wednesday, September 23
  - 10:00am – **Cerner Corporation**: Predict, Alert, Manage and Optimize an Ecosystem With Splunk. Speakers: Tom Twait, Chris Hogan
  - 10:45am – **Cerner Corporation**: Guerilla Marketing – How to Sell Splunk Internally to Your Enterprise. Speaker: Aaron Blythe
  - 11:15am – **Penn State Hershey Medical Center**: Building a Cyber Security Program with Splunk App for Enterprise Security. Speaker: Jeff Campbell
  - 12:15pm – **Kaiser Permanente**: Operationalizing Data Science Output Using Splunk. Speakers: Dave Dyer, Tim Neyman
  - 1:15pm – **Oscar Health**: Hold Me Closer Tiny Data. Speakers: Mackenzie Kosut, Timothy Faust
  - 3:15pm – **Kaiser Permanente**: Turning Indicators of Compromise into Tangible Protection. Speakers: Katie Winslow, Michael Slavick
  - 5:15pm – **The Vancouver Clinic**: Patient Privacy Monitoring with Splunk. Speaker: Davin Studer
- Thursday, September 24
  - 10:00am – **Kaiser Permanente**: Tracking Health Claims Status Across Multiple Formats, Forms, Systems and Platforms (and Not Losing Any!). Speaker: Stuart Sands

THANK YOU

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