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Just What the Doctor Ordered: Innovative Use Cases in Healthcare

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Joe Welsh

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

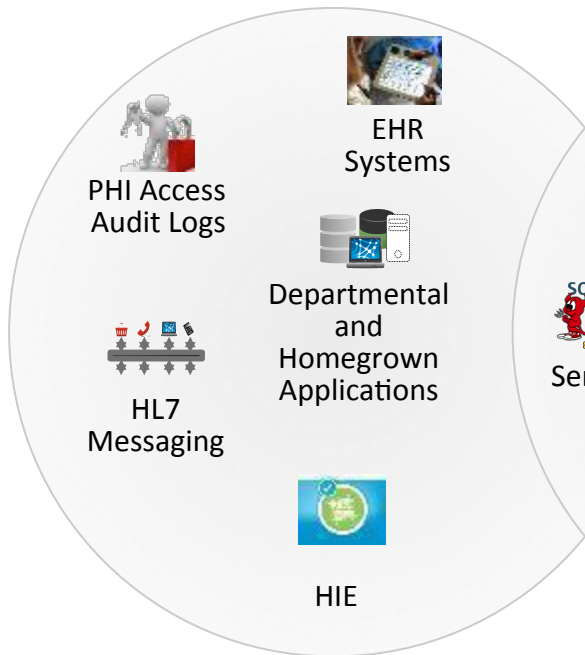
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During the course of this presentation, we may make forward looking statements regarding future events or the expected performance of the company. We caution you that such statements reflect our current expectations and estimates based on factors currently known to us and that actual events or results could differ materially. For important factors that may cause actual results to differ from those contained in our forward-looking statements, please review our filings with the SEC. The forward-looking statements made in the this presentation are being made as of the time and date of its live presentation. If reviewed after its live presentation, this presentation may not contain current or accurate information. We do not assume any obligation to update any forward looking statements we may make.

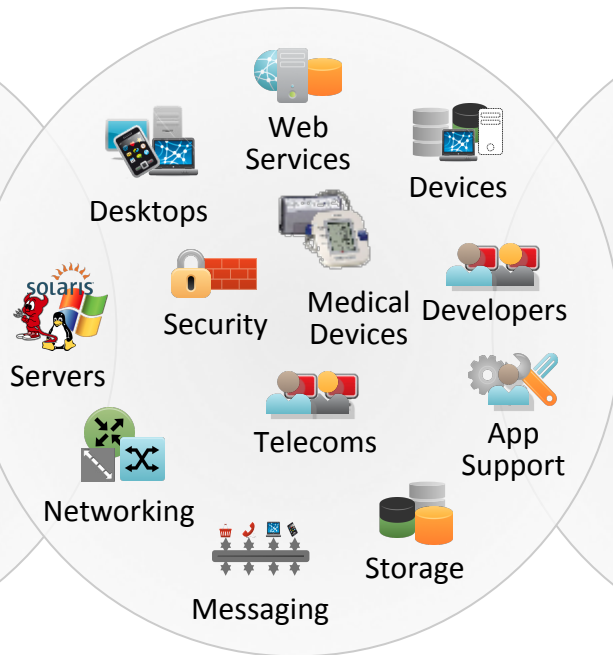
In addition, any information about our roadmap outlines our general product direction and is subject to change at any time without notice. It is for informational purposes only and shall not, be incorporated into any contract or other commitment. Splunk undertakes no obligation either to develop the features or functionality described or to include any such feature or functionality in a future release.

Healthcare Data is Time Oriented and Diverse

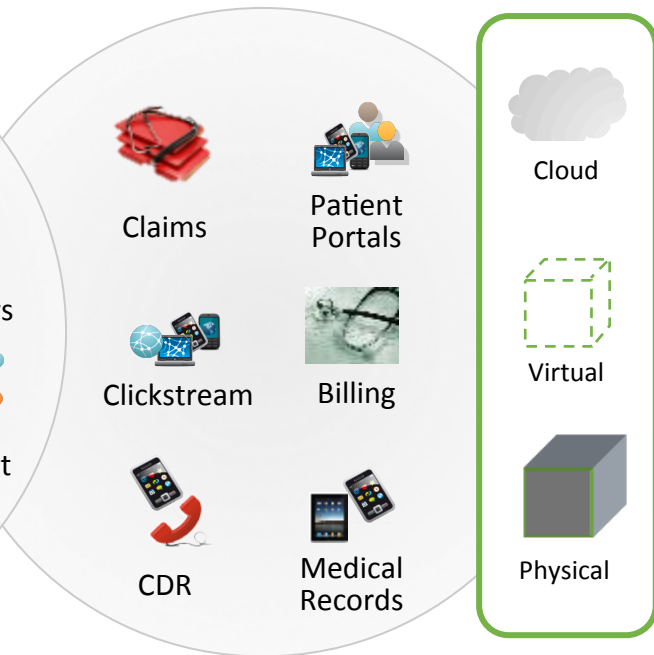
Healthcare Apps



IT Systems and Med Devices



Patient-Facing Data



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

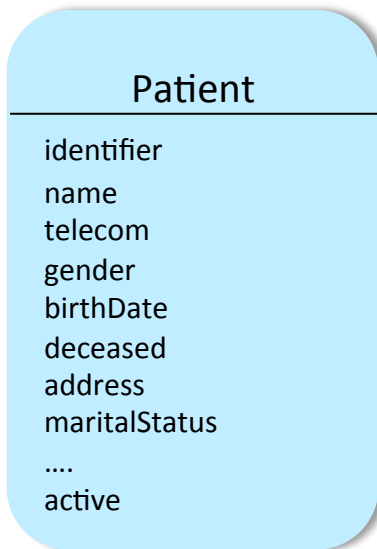
Provider scheduling

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"
    }
  ]
}
```



```
<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

Add new

[Fields](#) » [Field aliases](#) » Add new

Destination app *
splunk_healthcare_analytics

Name *
Patient Gender

Apply to *
sourcetype

named *
(?:.){0}*hi7_v2

Field aliases
PID_8 = gender Delete

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

Create Tags

Field Value: MSH_8=ADT^A01

Tag(s): Admit, Patient

Comma or space separated list of tags.

Buttons: Cancel, Save

New Search

 Index~hl7_v2? tag=Patient"

✓ 7 events (before 9/13/15 10:26:06.00 PM)

Job ▼ |

Events (7) Patterns Statistics Visualization

Format Timeline ▾ Zoom Out ➤ Zoom to Selection ✕ Deselect

List ▾ Format ▾ 20 Per Page ▾

< Hide Fields	≡ All Fields	i Time	Event
		>	MSH ^~\& EPIC GMH RHH RHH 20150324152437 CMB220 ADT^A01 7253902 I 2.3 EVN A01 20150324152437 ADT_EVENT BUSBYCHRIS^^^^OHSAS^^^OHSAS 20150324152432 PID 131006807000^EPI^NR ECGCARGE^PFRIMUS 19660124 M African Amer 1779 E HE ^FRANKLIN FRANKLIN (614)88-9999^PH^G614-888999 [ENG]SINGLE (6100215406 999-99- PD1 ONTARIOHEALTH TN 26172^JEFFERSMELISSA^^STAPPROV^STARPROV^STARPROV^STAR NK1 ECGCARGE^NAHCY^^Spouse AAAAJUS (614)88-9999^G614-888999 [Emergency Con
Selected Fields			Show all 15 lines
a gender 2			gender = M host = jwelsht-mbpri15.local source = Sample_Adt.msg sourcetype = cloverleaf_hl7_v2
a host 2			
a source 2			
a sourcetype 2			
Interesting Fields		>	MSH ^~\& EPIC GMH GMH 20150324152750 EDMD ADT^A01 725402 I 2.3 EVN A01 20150324152750 ADT_EVENT Model User EMERGENCY^ATTENDING-PHYSICIAN^ANAAA^HSA PID 131006806900^EPI^NR JURSESSHELLE 19880080 F *****US-P (6100215392) PD1 GRANT MEDICAL CENTER 1013100 PV1 I EDMG^B25+25^GMC1^R^*****DEPID 15802^BOEHMER^DAVID^C^****STARPROV^STAR 100215392 SELF ***** *****GMCA^***** 20150324140900 I 2215083003
a ack_packets_in 1			Show all 13 lines
a ack_packets_out 1			gender = F host = jwelsht-mbpri15.local source = Sample_Adt.msg sourcetype = cloverleaf_hl7_v2
a ALT 2			
a ALT_1 1			
a ALT_3 2			
a ALT_5 1			

Statistics, Machine Learning, and Visualization

1

Discovery

Discover
Diagnose
Enhance

2

Compliance

Detect
Monitor
Compare

3

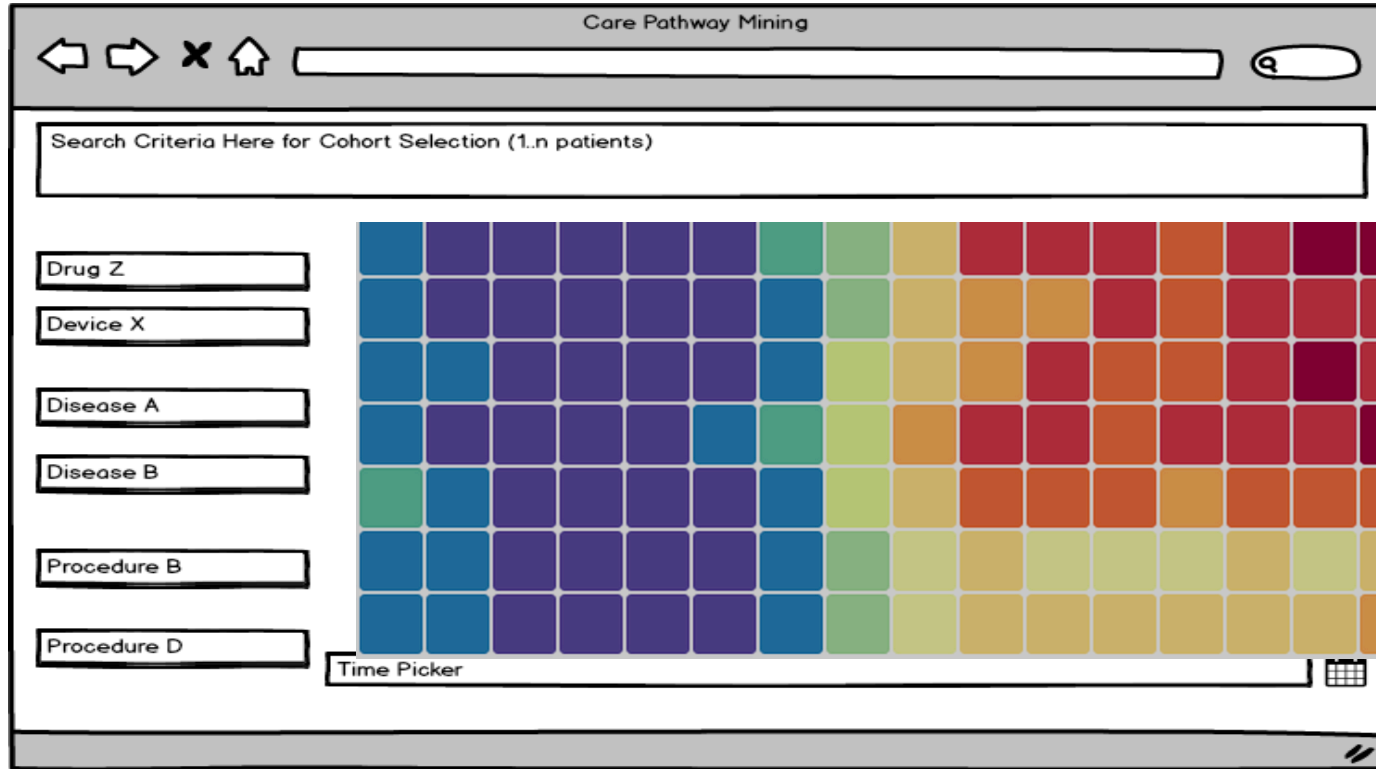
Prediction

Forecast
Predict
Recommend

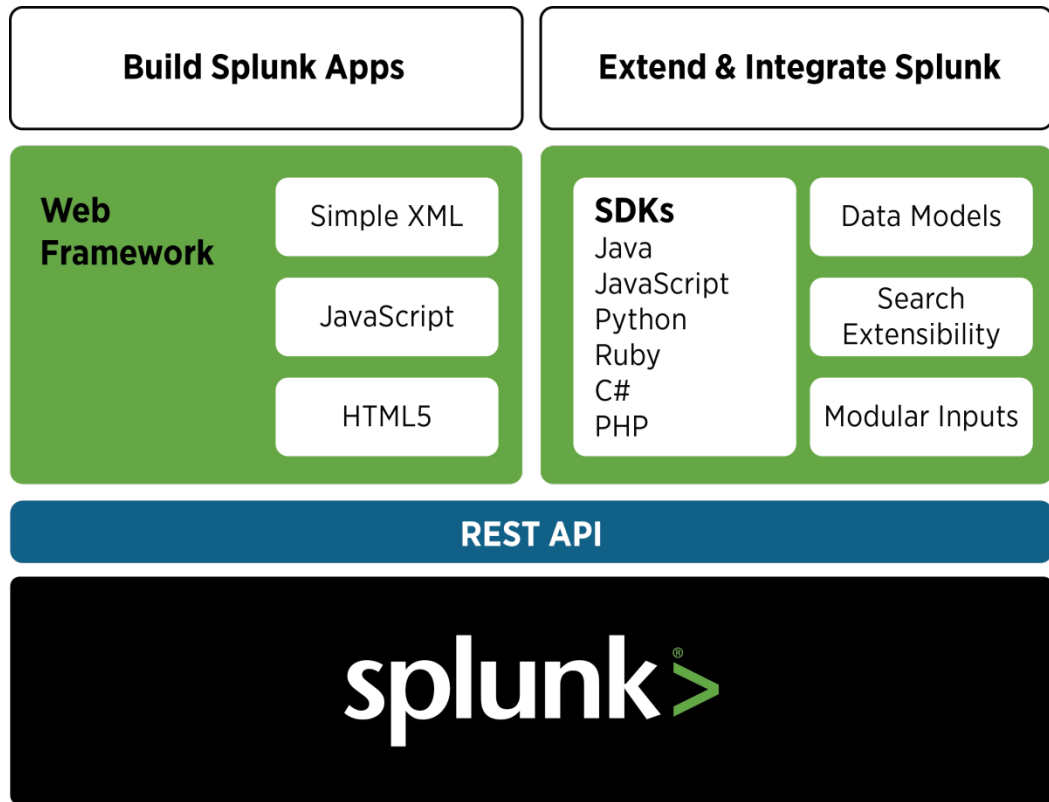
Examples of Machine Learning For Exploratory Data Analysis

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 <u>entropy</u> (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**

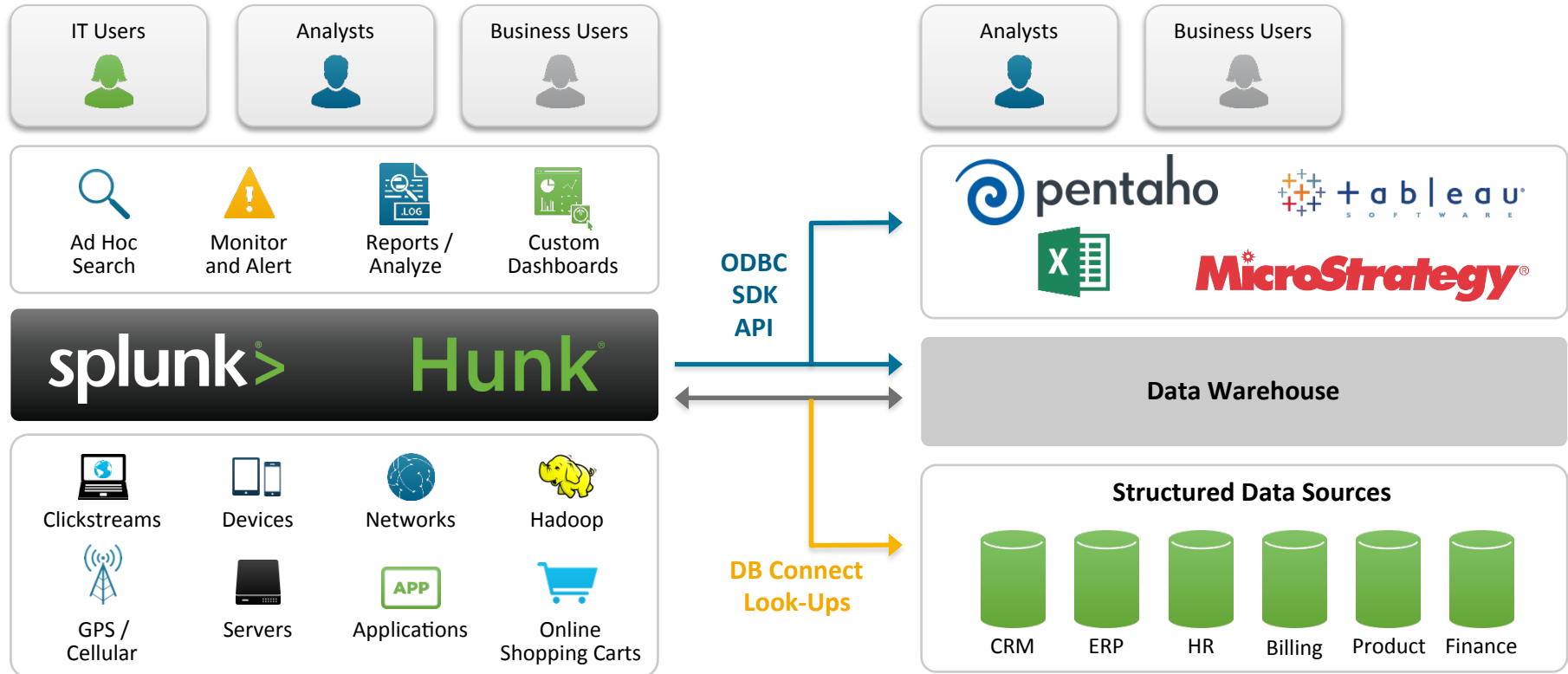
*Platform capable
of analytics on all
types of data from
diverse sources*

3

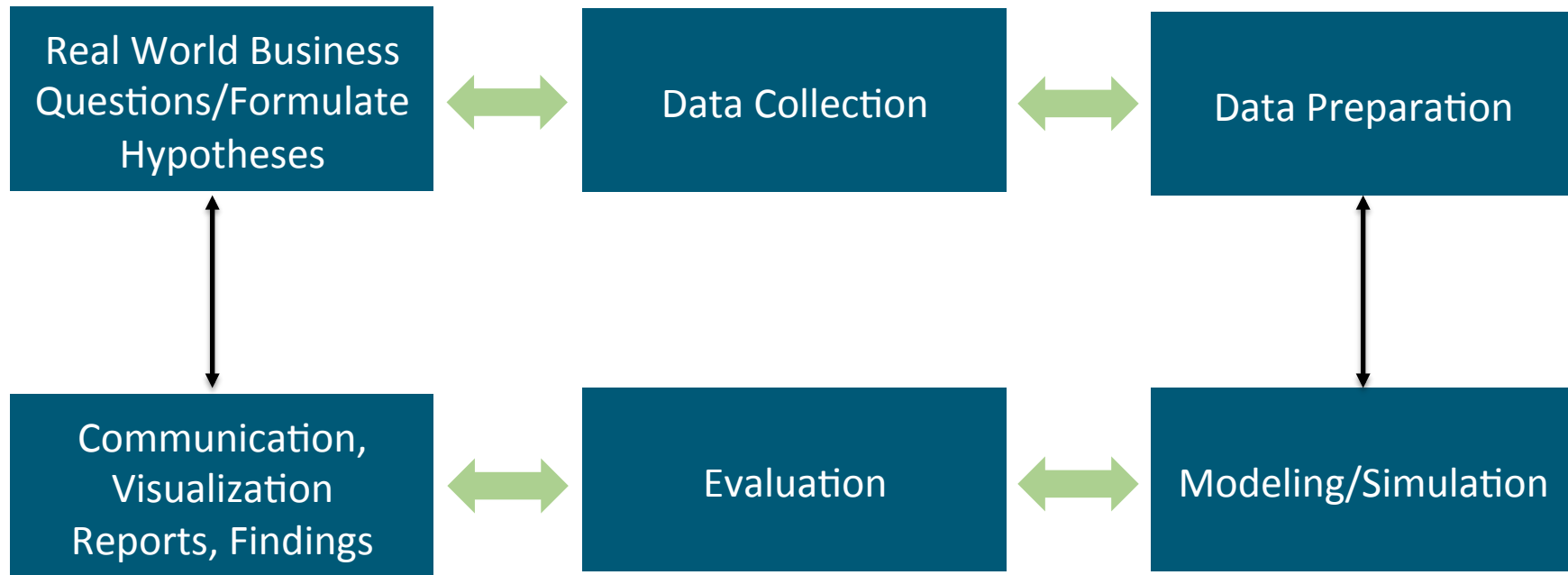
**System
interoperability**

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

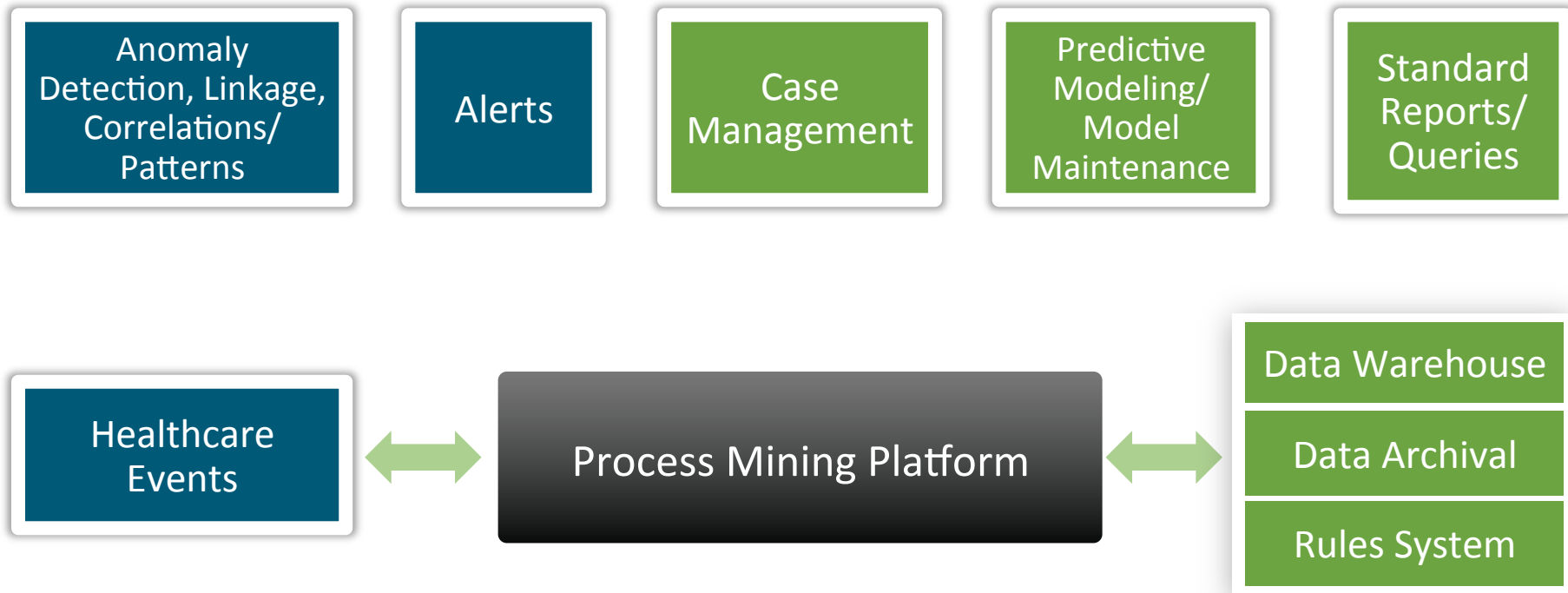
Ecosystem Integration



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



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THANK YOU

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