DevDays 10th Edition

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The SANER Project: Measuring Situational Awareness

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Who am I?

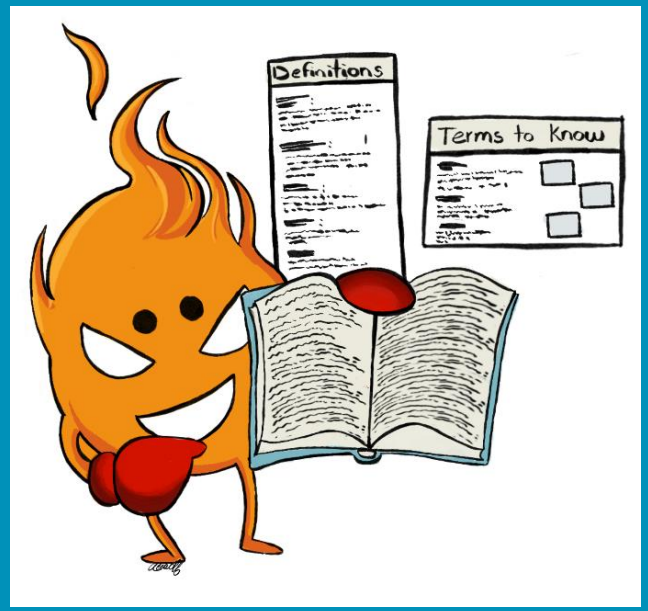
- Keith W. Boone
- Audacious Inquiry

Keith Boone is the technical lead for the SANER Project. He is an enterprise architect for Audacious Inquiry, leading the company's efforts in standards development in HL7, IHE and US national efforts. He has over 15 years of experience in HL7 and IHE efforts and has been the editor of over two dozen standards and implementation guides, including 5 using HL7 FHIR®.

Learning Objectives Tutorial/Let's Build

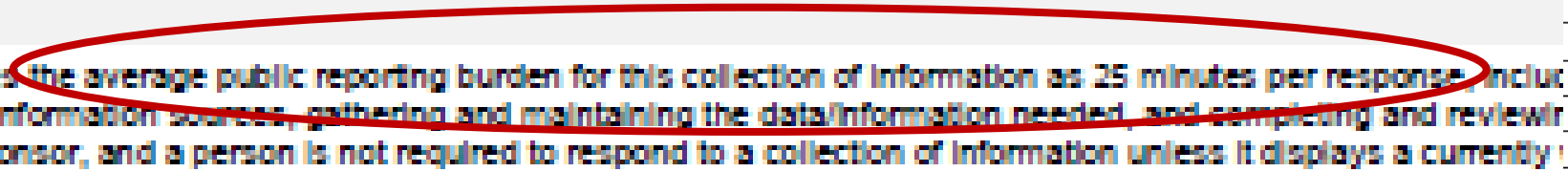
- This session will provide an overview of the HL7 FHIR SANER IG content and describe how it can be used to support situation awareness for emergencies such as the COVID Pandemic. We will explain the actors and operations supported by the HL7 FHIR SANER IG. We will also show real world examples of how MeasureReport resources can submitted to and retrieved from a SANER Server using simplified measure reporting in CSV format.
- The Let's Build part of this tutorial will provide instruction on how to build automatable Measure using the SANER IG and demonstrate the deployment and use of the Measure in operation using a SANER Server that implements the IG.

Definitions



What is the SANER Project?

- SANER stands for Situational Awareness for Novel Epidemic Response
  - It started with the insanity of needing manual reporting for bed and ventilator availability that hospital staff were required to do in early days of the COVID-19 response.
  - With FHIR APIs, we can do better.



COVID-19
Patient Impact and Hospital Capacity Module

Facility ID #: _____
Summary Census ID #: _____

***Date for which patient impact and hospital capacity counts are reported:** ____/____/_____

For the following questions, please collect data at the same time (for example, 7 AM)

Section 1: Patient Impact Data Elements

_____	**HOSPITALIZED:** Patients currently hospitalized in an inpatient bed who have suspected or confirmed COVID-19
_____	**HOSPITALIZED and VENTILATED:** Patients currently hospitalized in an inpatient bed who have suspected or confirmed COVID-19 and are on a mechanical ventilator
_____	**HOSPITAL ONSET:** Patients currently hospitalized in an inpatient bed with onset of suspected or confirmed COVID-19 fourteen or more days after hospital admission due to a condition other than COVID-19
_____	**ED/OVERFLOW:** Patients with suspected or confirmed COVID-19 who currently are in the Emergency Department (ED) or any overflow location awaiting an inpatient bed
_____	**ED/OVERFLOW and VENTILATED:** Patients with suspected or confirmed COVID-19 who currently are in the ED or any overflow location awaiting an inpatient bed and on a mechanical ventilator
_____	**DEATHS:** Patients with suspected or confirmed COVID-19 who died in the hospital, ED, or any overflow location on the date for which you are reporting

Section 2: Hospital Bed/ Intensive Care Unit (ICU)/ Ventilator Capacity Data Elements

_____	**ALL HOSPITAL BEDS:** total number of all inpatient and outpatient beds in your hospital, including all staffed, licensed, overflow, and surge or expansion beds used for inpatients and for outpatients (includes ICU beds)
_____	***HOSPITAL INPATIENT BEDS:** total number of staffed inpatient beds in your hospital including all licensed, overflow, and surge or expansion beds used for inpatients (includes ICU beds)
_____	**HOSPITAL INPATIENT BED OCCUPANCY:** total number of staffed inpatient beds that are occupied
_____	**ICU BEDS:** Total number of staffed inpatient ICU beds
_____	**ICU BED OCCUPANCY:** total number of staffed inpatient ICU beds that are occupied
_____	**MECHANICAL VENTILATORS:** Total number of ventilators available
_____	**MECHANICAL VENTILATORS IN USE:** total number of ventilators in use

Assurance of Confidentiality: The voluntarily provided information obtained in this surveillance system that would permit identification of any individual or institution is collected with a guarantee that it will be held in strict confidence, will be used only for the purposes stated, and will not otherwise be disclosed or released without the consent of the individual, or the institution in accordance with Sections 304, 306 and 308(d) of the Public Health Service Act (42 USC 242b, 242k, and 242m(d)).

CDC estimates the average public reporting burden for this collection of information as 25 minutes per response, including the time for reviewing instructions, searching existing data/information sources, gathering and maintaining the data/information needed, and completing and reviewing the collection of information. An agency may not

What is Situational Awareness?

- Situational Awareness and Essential Elements of Information are terms of art in Emergency Response
  - Communication of "Essential Elements of Information" or EEI
    - "Strategic EEI attributes are those that are required for the purposes of shared **situational awareness**, monitoring, and coordination support at regional or national levels."[1]
  - EEIs are Broadly defined in Emergency Response field for
    - Transportation (Air, Water, Rail, Roads)
    - Infrastructure (Power, Water, Fuel)
    - Communications
    - Affected Populations
    - Shelter
    - Command and Control
    - Healthcare
  - Typically under-specified in the Healthcare context
    - e.g., Operational Status and Location of Hospitals

[1] Essential Elements of Information Publication Guidance, National Information Sharing Consortium, 2015, https://www.nisconsortium.org/portal/resources/bin/NISC_EEI_Publication_1426695387.pdf

SANER defines new kind of Measures

- Capacity / Utilization
  - What do you have? How much is used?
- Event Counting
  - How many times did this happen today? Cumulatively over time?
- Queue Lengths
  - How many are waiting for Service?
- Service Time
  - How long are they waiting?
- Categorical
  - How many are in what status?

You Already Use These Measurements

What Response Agencies What to Know

- Capacity/Utilization
  - What's your normal/surge capacity?
  - How much of it is in use/available?
- Events
  - How many are infected?
  - Have recovered? Or died?
  - Been tested?
- Queue Length
  - How many are waiting for a Bed?
  - For a test?
- Service Time
  - How long does it take to get a bed?
  - Tested?
  - Treated?
  - Cured?
- What's your status on _____?

Similar Things You Measure Today

CPU / Memory
Disk Storage

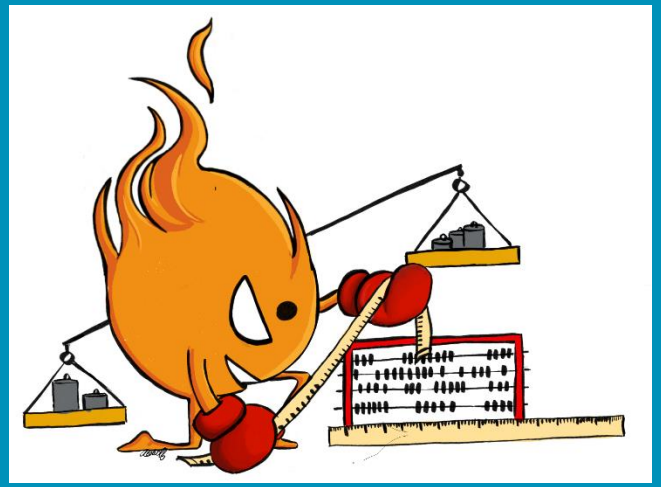
Search Hits
Error Counts / Bugs

Connection Pools
Sockets
Locks

Percentile Service Times
Average Response Time

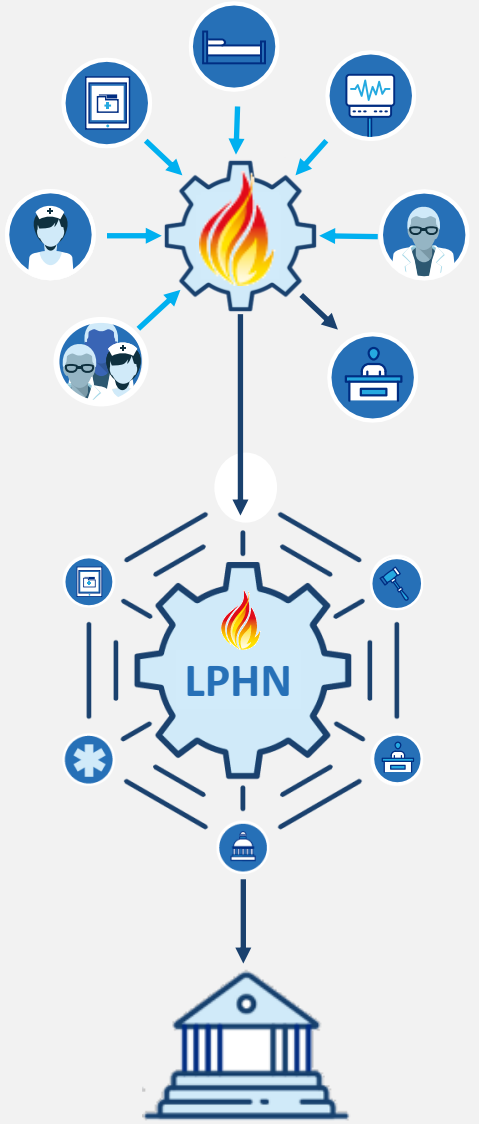
Red/Yellow/Green

Communicating Measurements



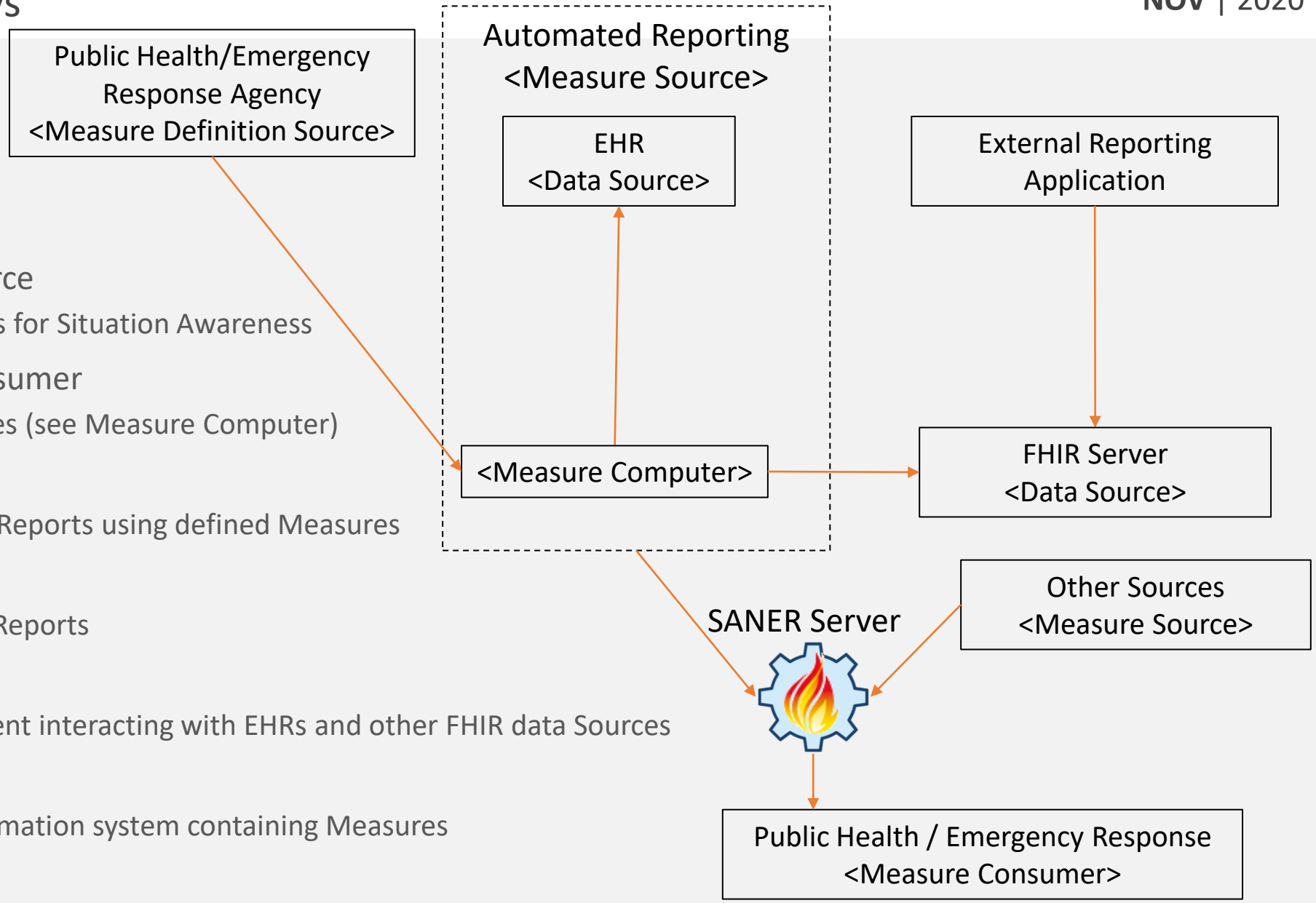
How does SANER communicate EEIs?

- Public Health and Emergency Response Agencies define measures of essential elements of information communicating Situational Awareness needs
- Hospitals and other healthcare provider organizations (e.g., ambulatory clinics, pharmacies, others) collect data locally from relevant information systems.
- A SANER Server aggregates data from relevant systems into a combined report to Public Health and Emergency Response Agencies through the local public health network.
- Data is shared as appropriate at the local, regional and national level



Actors

- Measure Definition Source
  - Publisher of Measures for Situation Awareness
- Measure Definition Consumer
  - Consumer of Measures (see Measure Computer)
- Measure Source
  - Reporter of Measure Reports using defined Measures
- Measure Consumer
  - Receiver of Measure Reports
- Measure Computer
  - Automation Component interacting with EHRs and other FHIR data Sources
- Data Source
  - An EHR or other information system containing Measures
- Measure Intermediary
  - Helper Systems, Interface Engines, Aggregators, other related systems



Not All Measure Sources are Created Equal

SANER enables Reporting from non-FHIR-enabled systems

- FHIR enabled systems aren't the only sources of data.
- Measures are pretty simple, just about anything with a database can count!
- SANER defines an operation to convert from CSV format

  [base]/Measure/[id]/$report-csv
- And read or search in CSV format

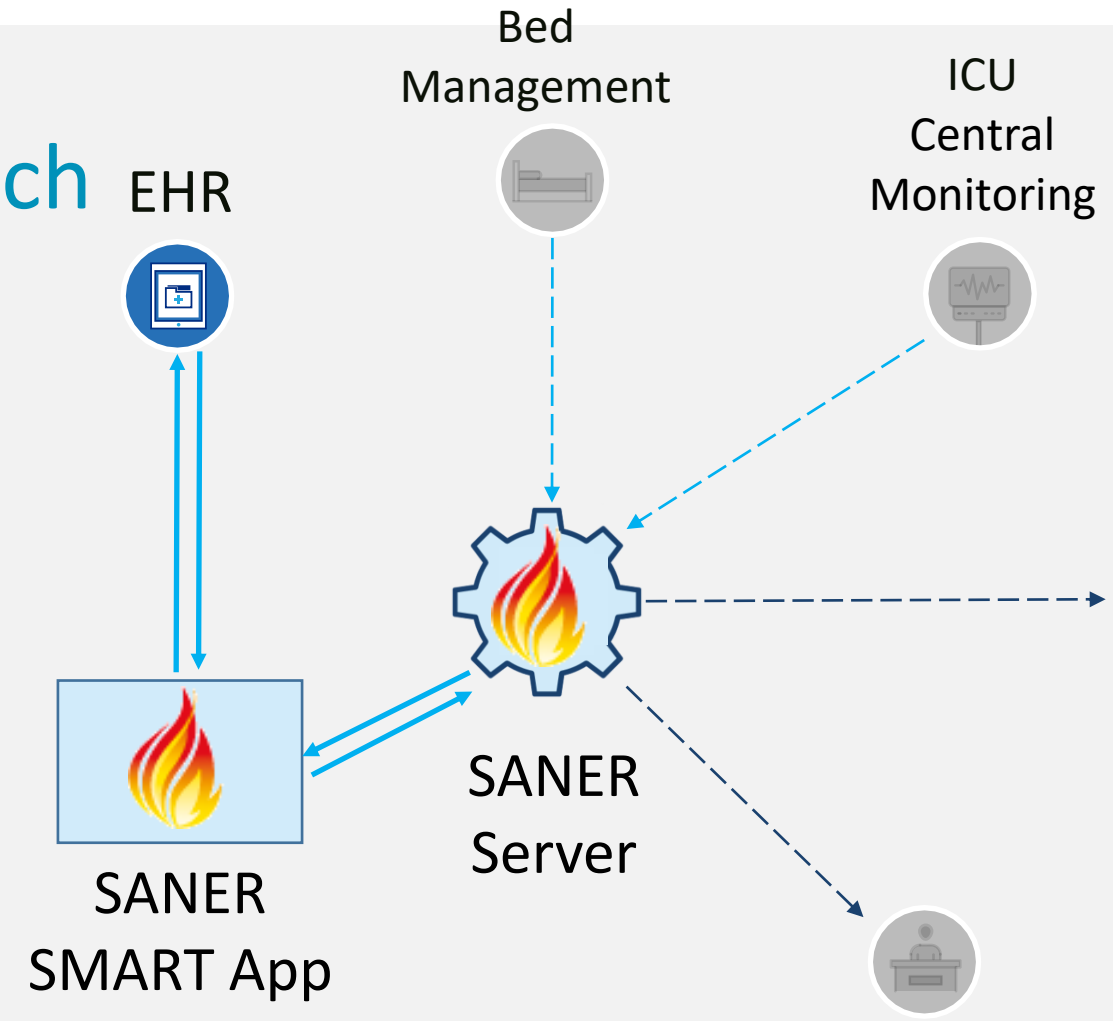
  [base]/MeasureReport/[id]/$read-csv

  [base]/MeasureReport/[id]/$search-csv

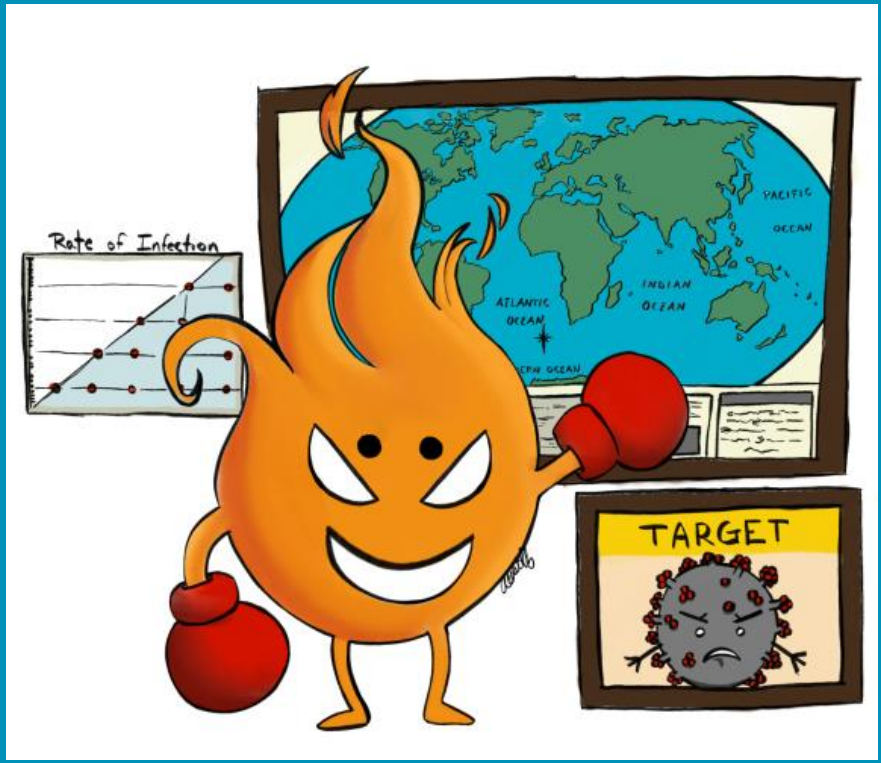
Use	Name	Cardinality	Type	Binding	Documentation
IN	input	1..1	Binary		The input of the request is a CSV file with labeled columns containing the data in the report.
IN	map	0..*	string (composite)		Each parameter is a composite of column to measure mappings
IN	period-end	1..1	string (date)		The end of the reporting period.
IN	period-start	1..1	string (date)		The start of the reporting period.
IN	reporter	0..1	string (reference)		reporter for the MeasureReport. If unspecified, the server may determine the reporter based on business rules (e.g., based on the identity of the sender).
IN	subject	0..1	string (reference)		subject for the MeasureReport. If unspecified, the server may determine the subject based on business rules (e.g., based on the identity of the sender).
OUT	return	0..1	Bundle		The result of the reporting operation

A Complete Reporting Approach

- SANER SMART on FHIR App
  - Authorizes with Hospital EHR
  - Queries for Applicable Data
  - Creates Measure Reports from EHR
  - Stored to SANER Server
- SANER Server
  - Collects Data from
    - SANER SMART on FHIR App
    - Other Data Sources (e.g. Bed Management, ICU Central Monitoring
  - Report Measure Data to
    - Local Command and Control
    - Regional/State Public Health



Automating Measures



SANER support multiple languages for automation

FHIRPath

- Widely implemented in multiple platforms
- Not always easy to read
- Is a subset of CQL

Clinical Quality Language (CQL)

- Not as widely implemented
- Easier to read

Writing FHIRPath Expressions for Counting Measure Populations

Counting Beds

* criteria.name = "NumTotBedsOcc"
* criteria.description = """Identifies the number of beds in use by counting the most recent location in the most recent Encounter for each patient where the encounter was in-progress or finished within the period. """
 * criteria.language = #text/fhirpath
 * criteria.expression = """

```
// Find all active encounters
findAll('Encounter',
 including('subject','condition','reasonReference'),
 with('status').equalTo('in-progress'),
 with('date').within(%ReportingPeriod)
).onServers(%Base)
// Select the most recent encounter for each location. Assumes that encounters
// are returned in reverse chonological order and that the most recent location is
// reported first in the list of locations.
.aggregate(
  iif($total.select(location[0]).location contains $this.location.location.first(),
     $total,
     $total | $this
  )
)
// NOTE: Aggregate returns a list of both Encounter and Location resources
// representing beds in use.   Allows stratification by Encounter or Location
```

Stratifying

* with group[4].stratifier
 ** code.text = "By Type of Location"
 ** description = "Inpatient Non-ICU, Inpatient ICU, Other"
 ** criteria.description = """Determines the location of the encounter based on the membership of location.type in the InpatientNonICU and InpatientICU ValueSet resources. When location.type is assigned to any other value, it is reported to be Other"""
 ** criteria.language = #text/fhirpath
 ** criteria.expression = """

```
  Encounter.location.location.resolve()
  .iif(type.memberOf(%NonICU.memberOf(.url),
     'Inpatient Non-ICU',
     iif (type.memberOf(%ICULocations.url),
        'Inpatient ICU',
        'Other'
     )
  )
"""
```

FluentQuery simplifies FHIRPath Search Expression Generation

Before FluentQuery

```
( %Base + 'Encounter?' +
  '_include=Encounter:subject&_include=Encounter:condition&' +
  '_include=Encounter:reasonReference' +
  '&status=in-progress,finished' +
  '&date=ge' + %ReportingPeriod.start.toString() +
  '&date=lt' + %ReportingPeriod.end.toString()
).resolve().select(entry.resource)
```

After FluentQuery

```
findAll('Encounter',
  including('subject','condition','reasonReference'),
  with('status').equalTo('in-progress'|'finished'),
  with('date').within(%ReportingPeriod)
).onServers(%Base)
```

Use of FluentQuery is not a requirement of the SANER Guide … unless you want people to be able to understand what you are doing ;-)

Situation Awareness and other Measures are Different

Situation Awareness Measures

- Coarse grained
- Based on limited evidence
- And limited information
- Change over time
- Can rely on dirty data

Other Measures

- Can deal with fine distinctions
- Based on well defined evidence
- Defined after detailed research
- Remain consistent over time
- Accuracy is more important

Excercise

- Pick a Resource
  - Treatment
  - People with skills
  - PPE
  - Something else?
- What do you need to know to deploy it appropriately?
  - Where is the most urgent need?
  - Who will get the most value out of it?
  - How will you determine that?
- What is your measure?

Let's Build It Together

Q&A

<At end of presentation> What did you learn?

- Situational Awareness is about communicating essential elements of information.
- Essential Elements of Information are key measurements needed to assess and respond to a situation.
- Multiple systems have essential elements of information, and not all of these may be FHIR enabled.
- Data can be converted from or to CSV (or other formats!)

Contact

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