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Enhancing Contrast Dose Informatics – A closed loop model using DICOM

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Enhancing Contrast Dose Informatics

- Introduction
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Introduction

- The administration of Contrast agent to patient as part of imaging procedure has been widely adopted for enhancing diagnostic quality.

- With the advent of intelligent Contrast-injector devices, contrast agent administration could be planned, programmed, performed and reported from contrast-infusion workstation.

- We discuss various ways enabling automation of flow of contrast agent administration information starting from the protocoling stage until reporting and helping enhancement of radiology workflow, and preventing workflow errors.

Contrast Agent Admin. SR (Sup. 164)

Currently, DICOM Contrast-Agent Adhoc Group is working on structuring contrast agent administration data under new DICOM objects (Supplement 164).

- Scheduled Contrast Agent Administration SR
- Performed Contrast Agent Administration SR
- Basic Contrast Agent Administration

Contrast Agent Admin. SR (Sup. 164)

Scheduled Contrast Agent Administration SR

- The *Scheduled Contrast Administration* object is intended for representing the plan or program to deliver contrast agent to the patient for a contrast study. It could be programmed at the time of schedule of a study or beginning of the study. The plan may be altered by the delivery system.
- Contains details of contrast, flush, delivery plan, contrast consumable like contrast type, needle gauge, injection device information, etc.
- Can be created by a radiologist prior to the study, using independent “Protocoling Client”. The scheduled objects could then be pushed to Infusion Manager.

Contrast Agent Admin. SR (Sup. 164)

Performed Contrast Agent Administration SR

- The *Performed Contrast Administration SR* is for reporting the data of plan that was “actually delivered” during the medical imaging procedure.

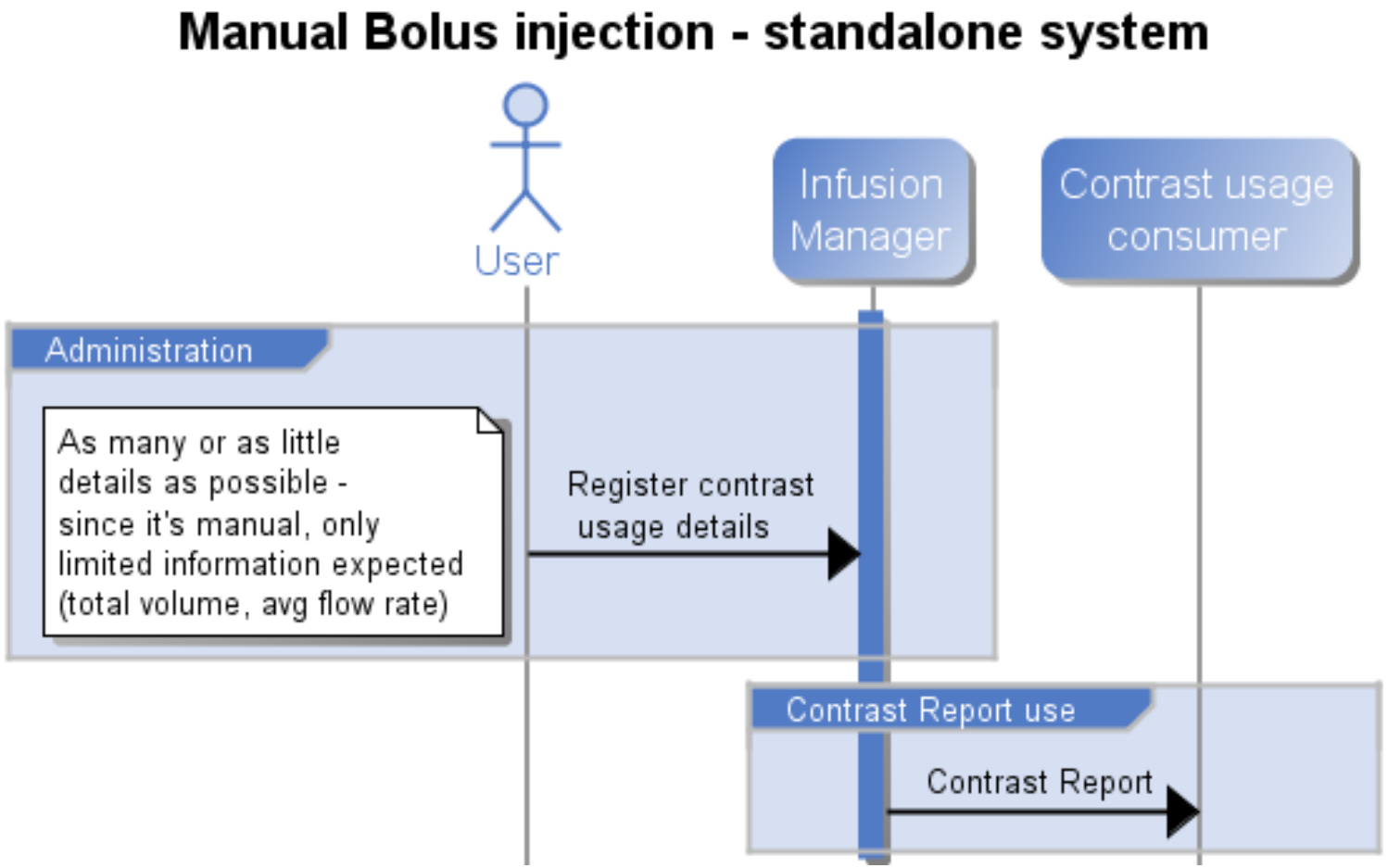
- Contains details of contrast, flush, programmed plan, delivered plan, contrast consumable like contrast type, needle gauge, injection device information, along with adverse event details etc.

Contrast Agent Admin. SR (Sup. 164)

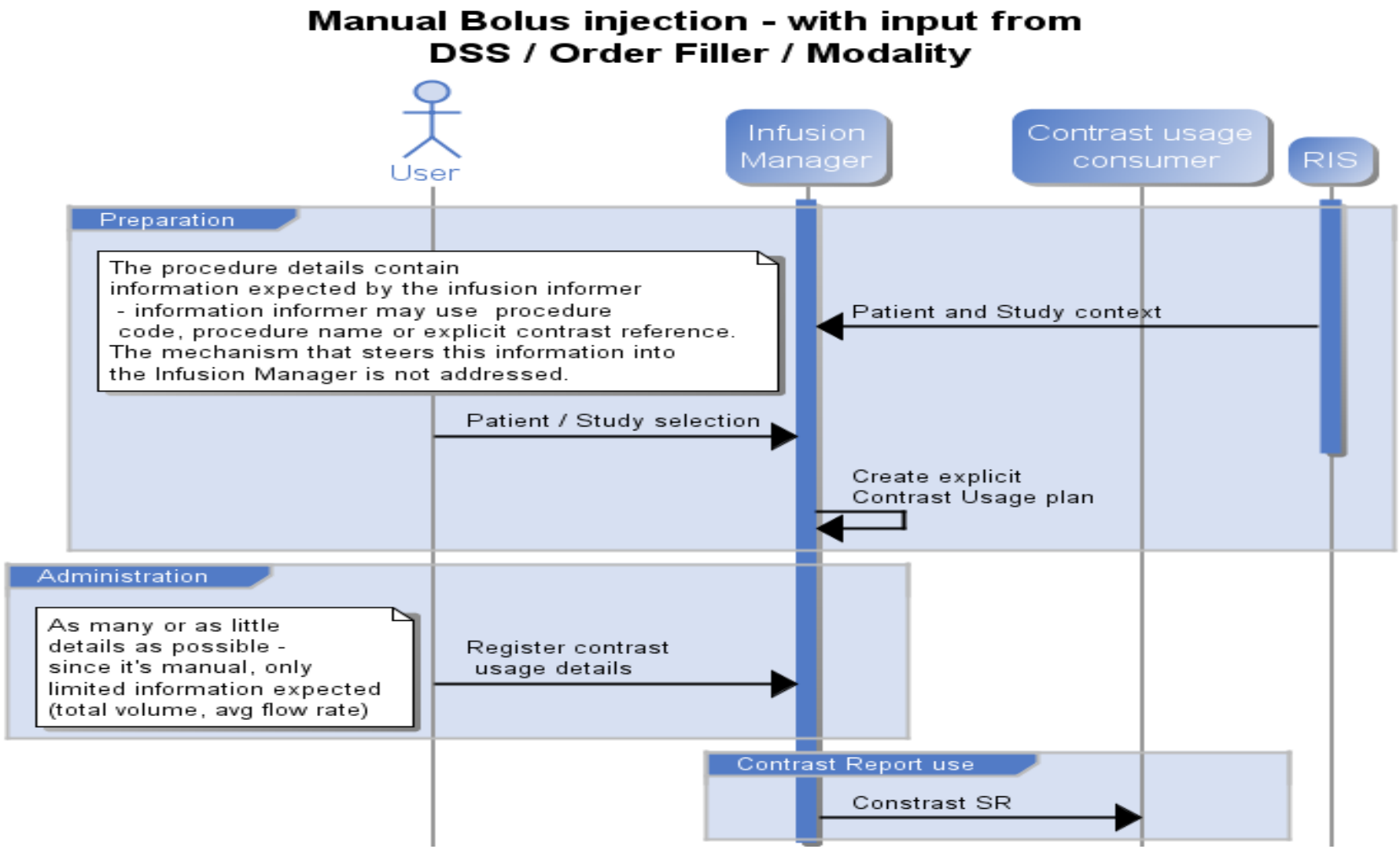
Basic Contrast Agent Administration SOP Class

- The *Basic Contrast Administration* is attribute based object for consumers like Acquisition Systems to obtain a summary of the administered contrast data.
- Simple attribute based object with new “Contrast/Bolus Agent IE” (Refer: Supplement 164, work-in-progress)

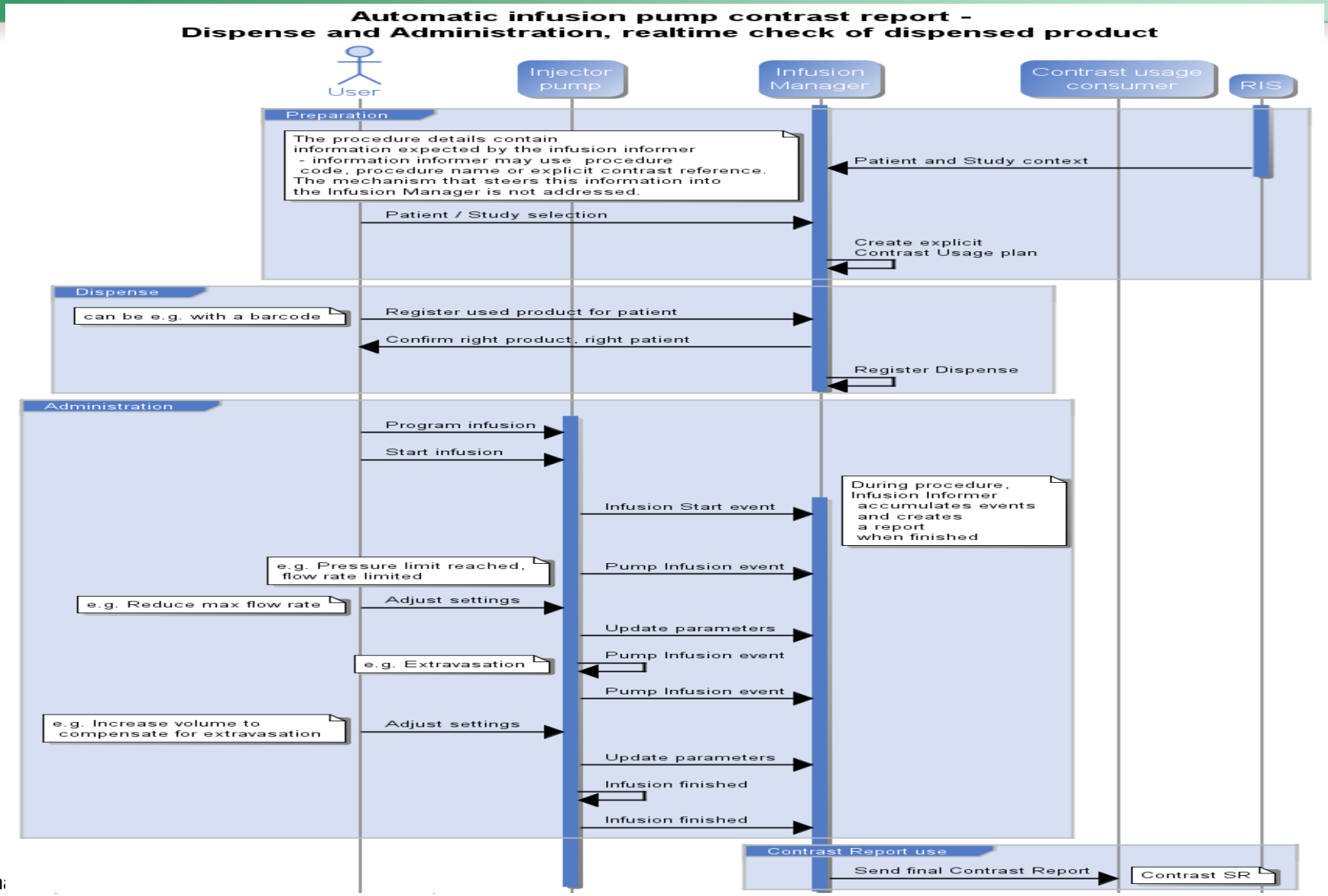
Use cases – Manual Injection



Use cases – Manual injection with input from RIS



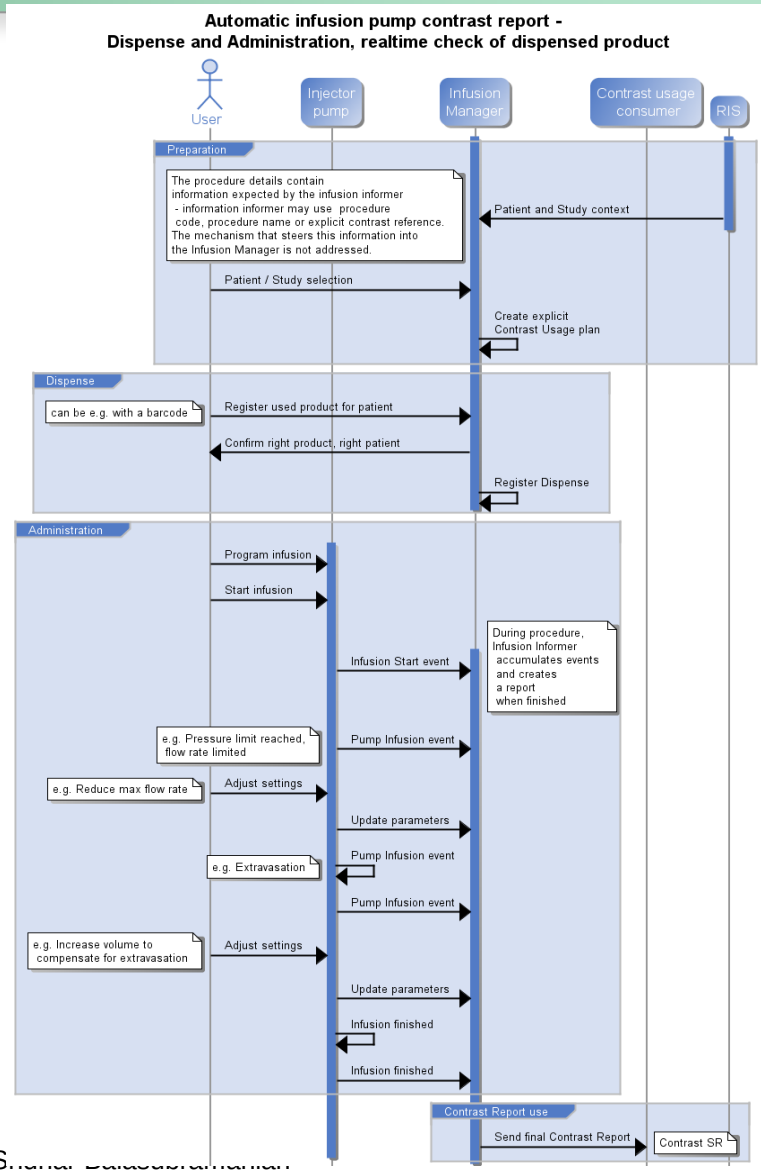
Use cases – Dispense, Administration, Real-time check



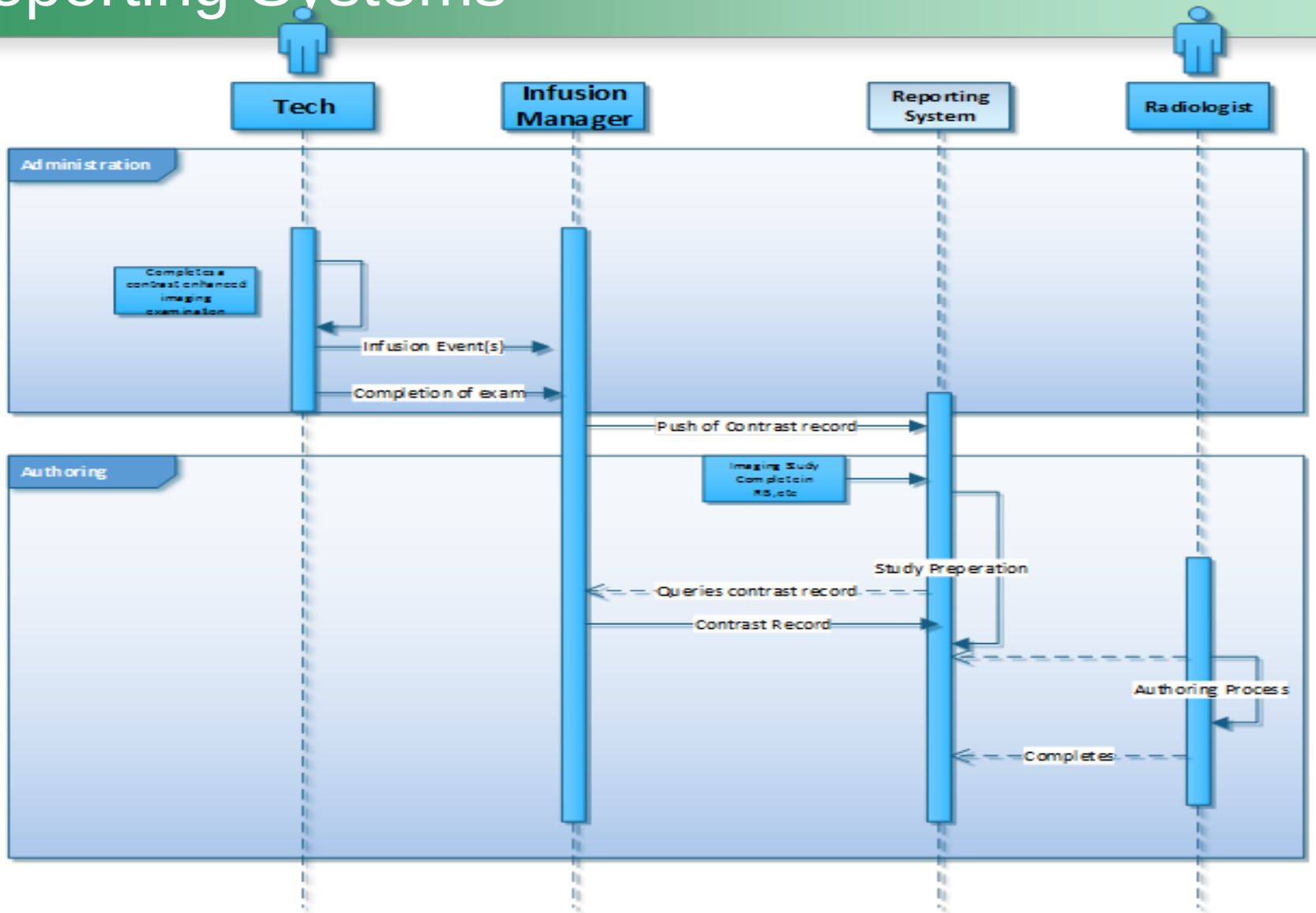
Enh
model using DICOM

Use cases – Dispense, Administration, Real-time check

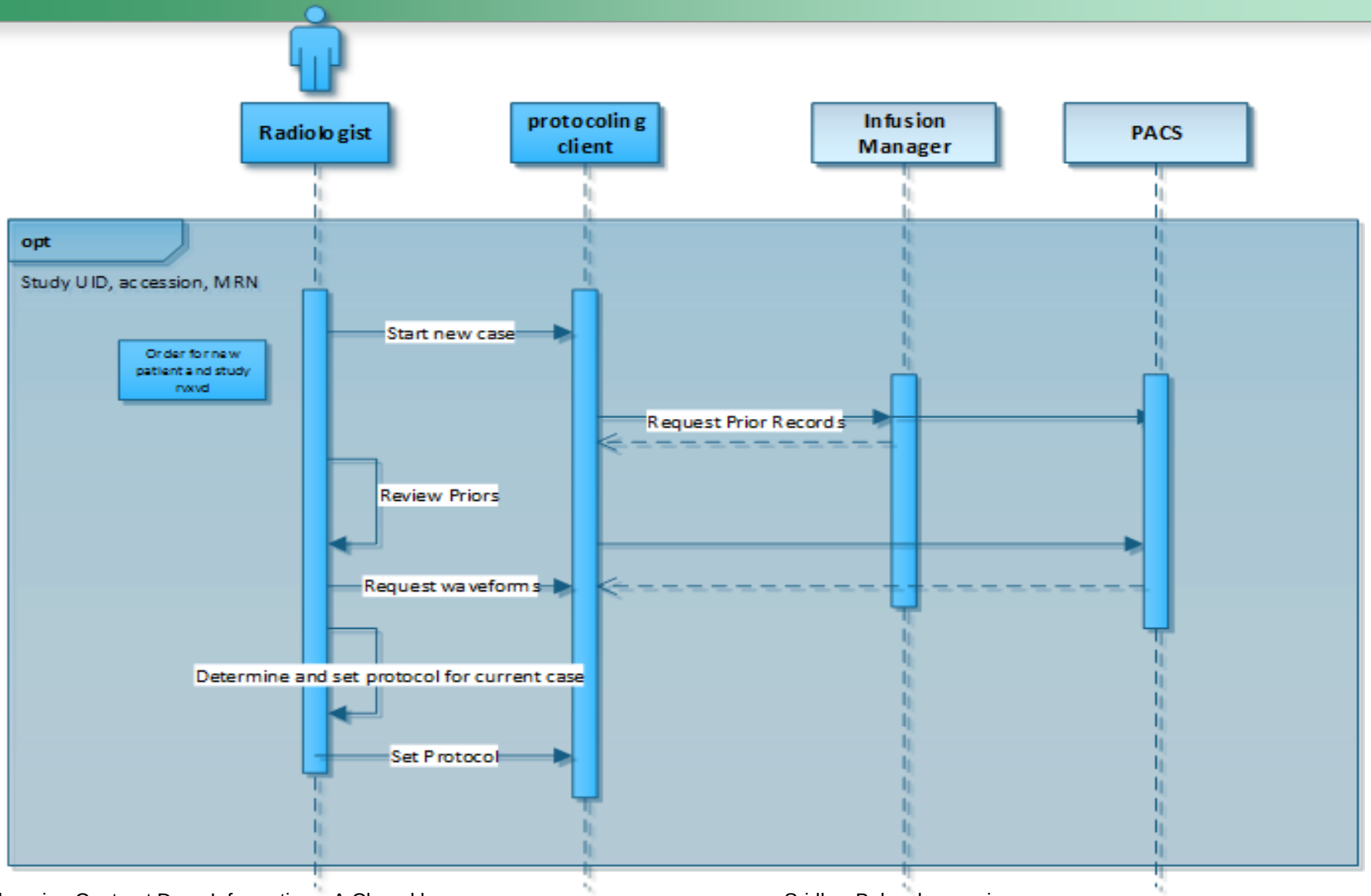
- Tech selects patient from MWL
- Programs contrast protocol for the study
- Obtains substance context
  (brand, mg/ml, expiry date, etc.)
- Confirm right product for right patient
- Start infusion, complete infusion
- Create contrast agent admin. SR
- Push SR object to hospital systems



Use case – Integration with Reporting Systems

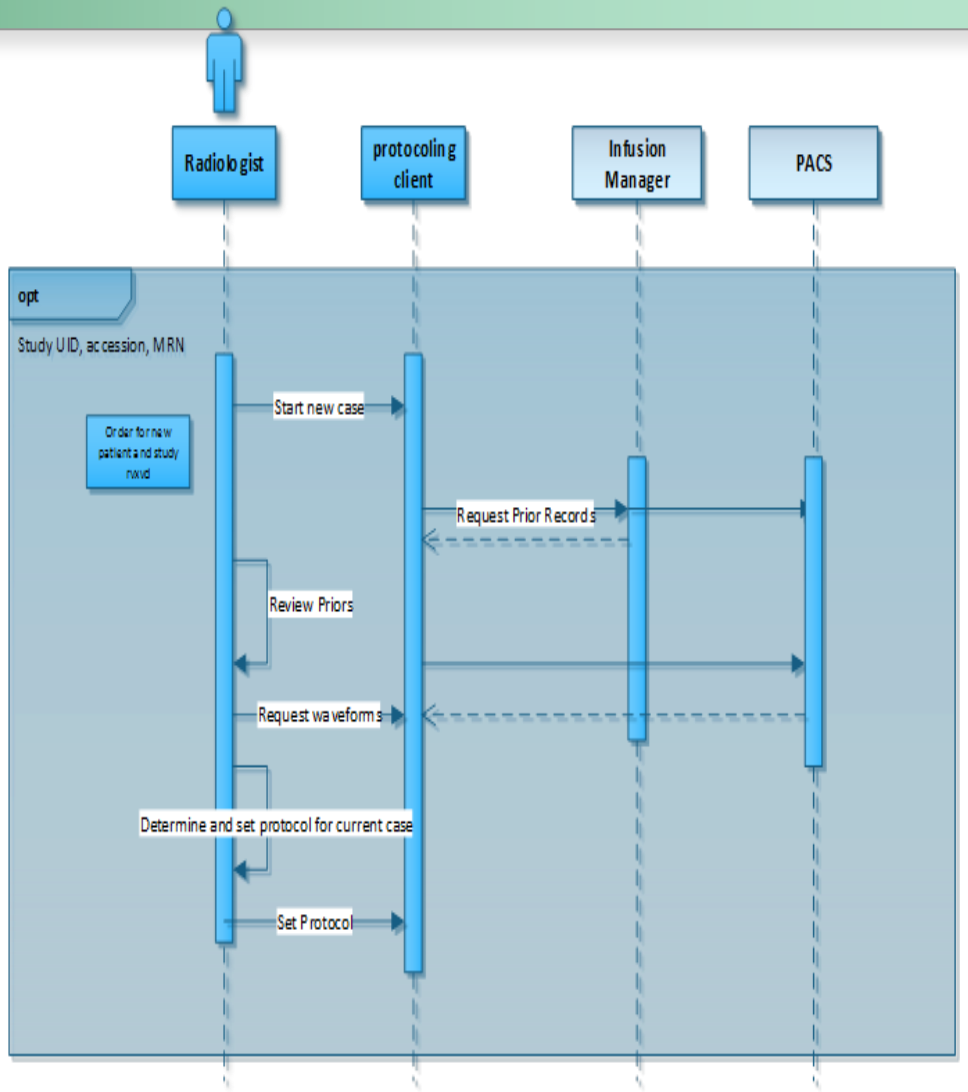


Use case - Protocoling



Use case - Protocoling

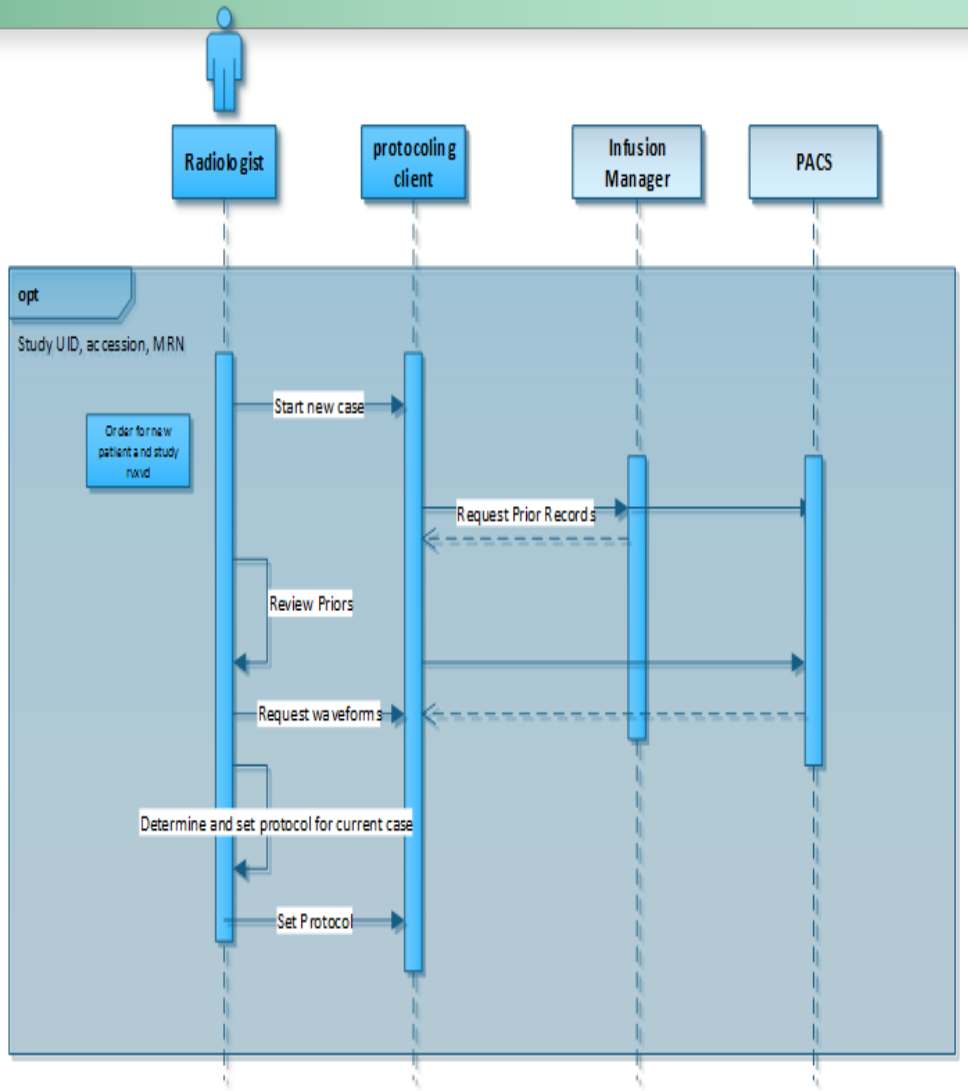
- Radiologists can ‘customize’ contrast injection steps for individual studies using “Protocoling Client” prior to a study.
- Protocoling client creates “Scheduled Contrast Admin. SR” objects
- Objects pushed to Infusion Manager for contrast delivery.



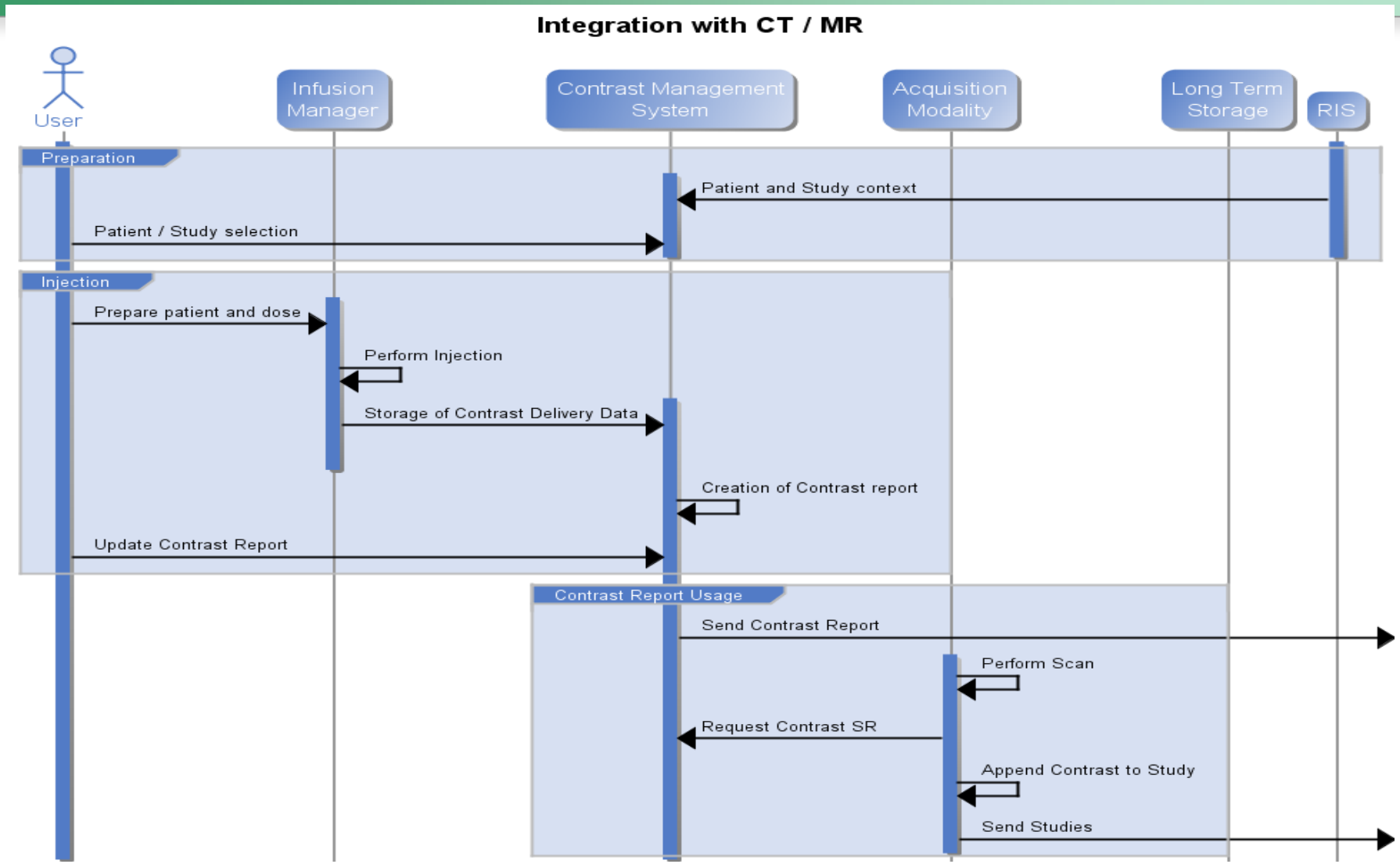
Use case - Protocoling

- Infusion Manager could pull "Scheduled Contrast Admin. SR" objects from a protocoling client.

- Object could be pushed to PACS too.

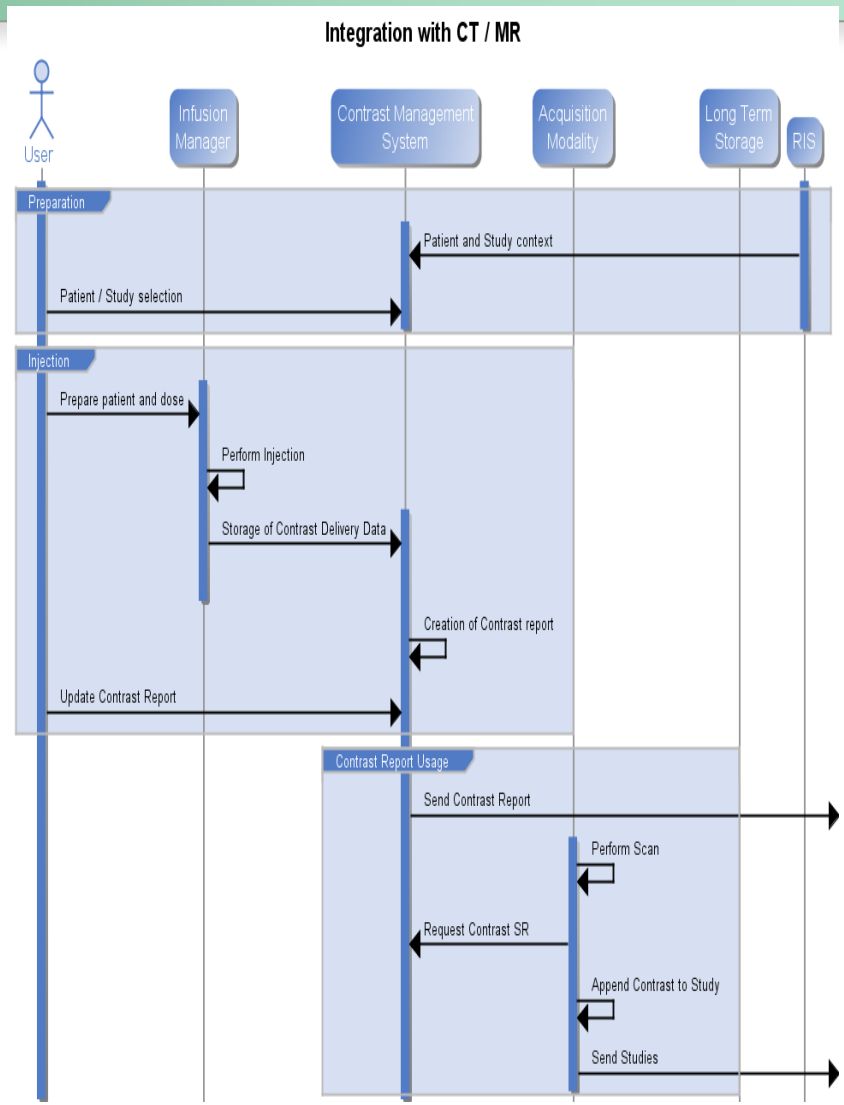


Use cases – Integration with CT/MR



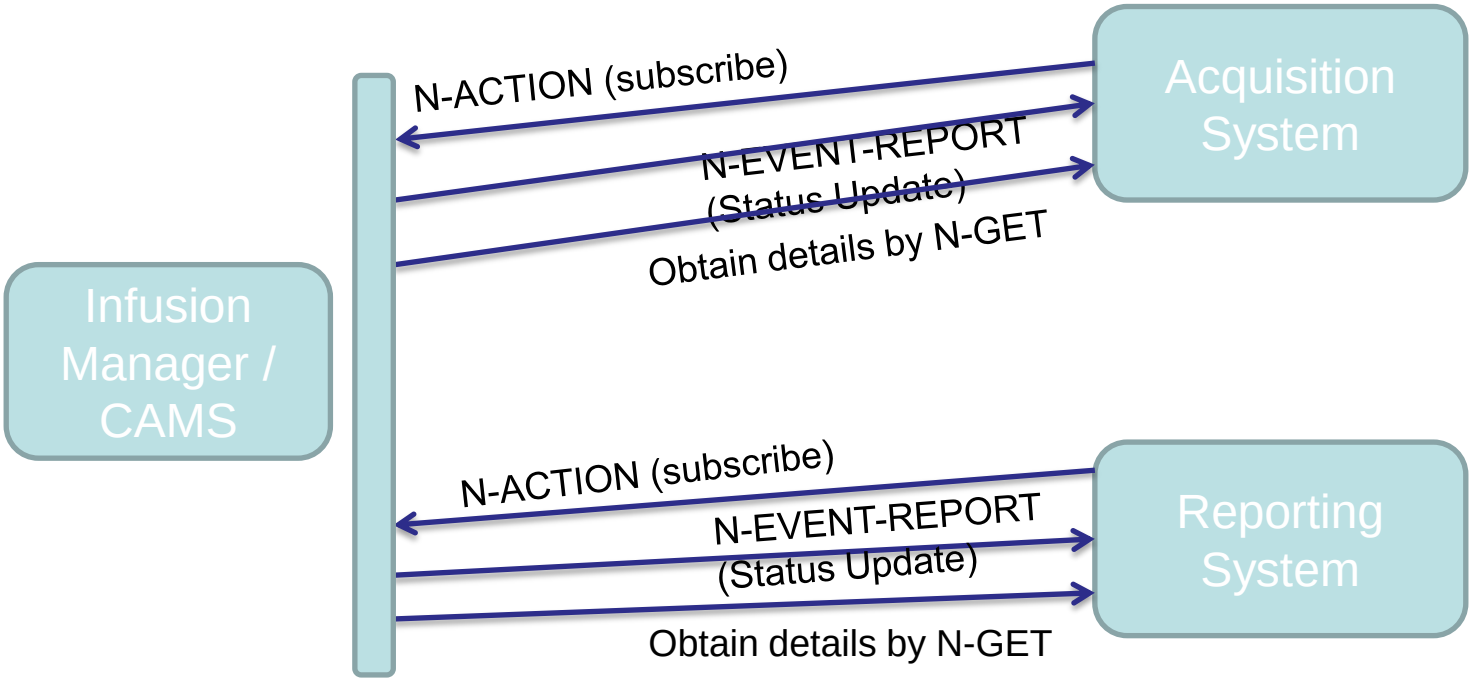
Use cases – Integration with CT/MR

- Obtain patient context from MWL
- Start Infusion, complete infusion
- Create contrast summary object, an attribute based ‘Basic Contrast Admin.’ object
- Push ‘basic’ object to Modality
- Modality could also query/retrieve from infusion manager



Using Unified Procedure Step

UPS Watch SOP and UPS Event SOP classes can be used to close the gap between virtually any system, interested in contrast administration data.



Using Unified Procedure Step

UPS Watch SOP and UPS Event SOP classes can be used to close the gap between virtually any system, interested in contrast administration data.

- **N-ACTION**: Interested consumers like Acquisition Systems may initiate subscription, in order to receive N-EVENT-REPORT.

- **N-EVENT-REPORT**: Interested consumers like Acquisition Systems may subscribe to the Infusion Manager, in order to receive N-EVENT-REPORT, to receive notifications that the new UPS has scheduled, started, stopped, updated and completed. The consumer may decide on how-much or how-little it wants to do with event contents.

Using Unified Procedure Step

- **N-GET**: Upon completion status, consumers can N-GET contents what it needs.

To Summarize, any interested consumer like Acquisition System or Protocoling Client can initiate N-ACTION with the Infusion Manager in order to subscribe, then wait for N-EVENT-REPORT for injection administration completion status and then N-GET in order to obtain required contrast administration data.

- Two ways for clients to obtain content using N-GET RQ.

Using Unified Procedure Step

1. Performed Processing Parameters Sequence (0074,1212):

- Allows a CONTAINER, where one can encode the summary information on the performed contrast administration.
- No need to C-MOVE the Contrast Admin. SR instances from the Infusion Manager

2. Output Information Sequence (0040,4033):

- The Contrast Administration related SR instances are referenced under this sequence, which then could be C-MOVE'd from Infusion Manager.
- No data encoded part of this sequence.

Using Substance Administration Query Service Class

Infusion Managers could benefit from Substance Administration Query Service Class in number of ways, to improve work-flow and improve patient safety.

a. Package Identification (Product Characteristics)

- Infusion Manager acquires Contrast Media details with the use of Barcode reader.
- The infusion Manager could act as a SAQ SCP that provides the information about contrast media details upon query received from clients like Acquisition Systems or Reporting Systems.
- Contrast-Media data like Contrast-Brand, Concentration, Volume, Active Ingredient information could be encoded part of Product Parameter Sequence (0044,0013)

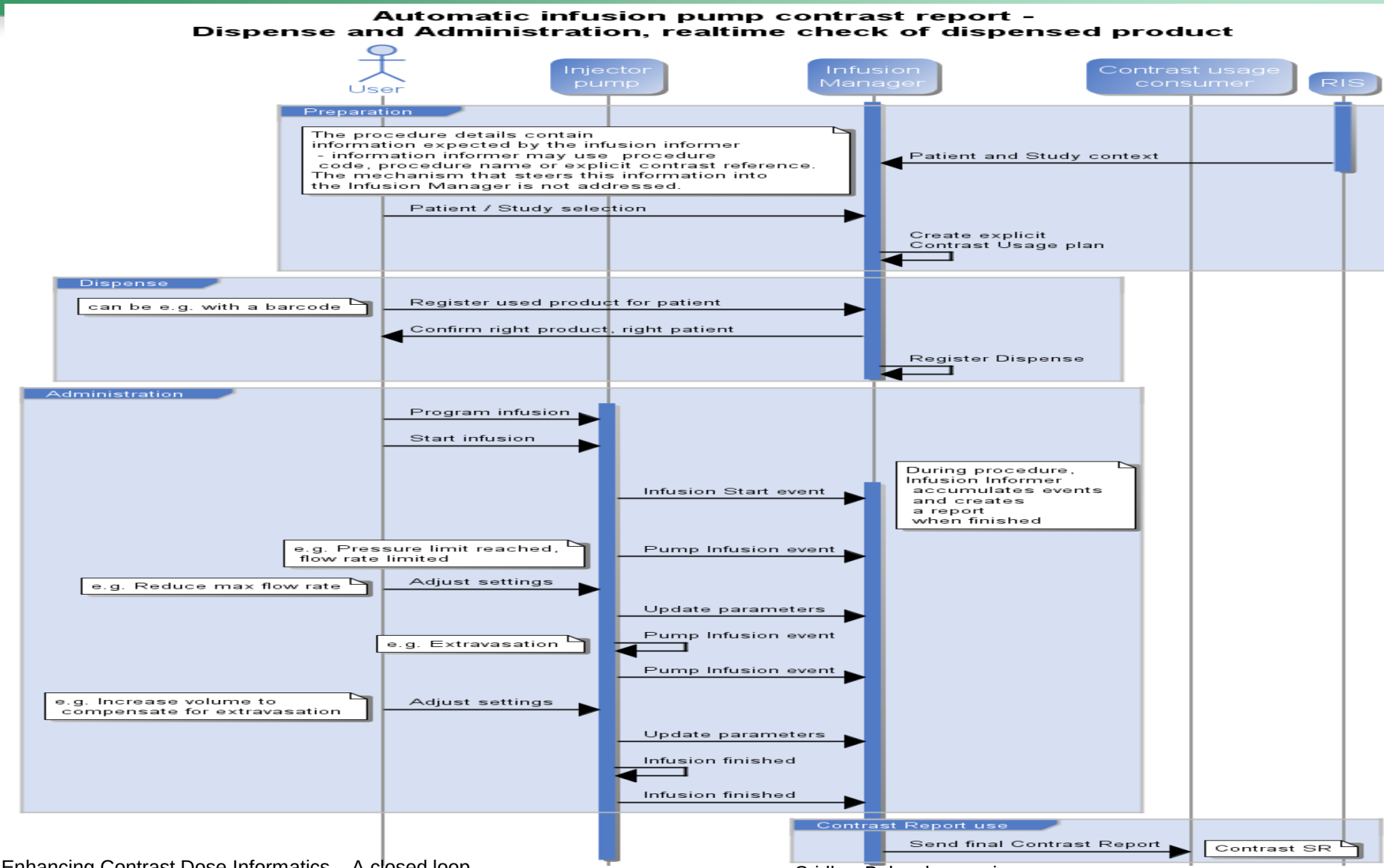
Using Substance Administration Query Service Class

b. Substance Approval Module

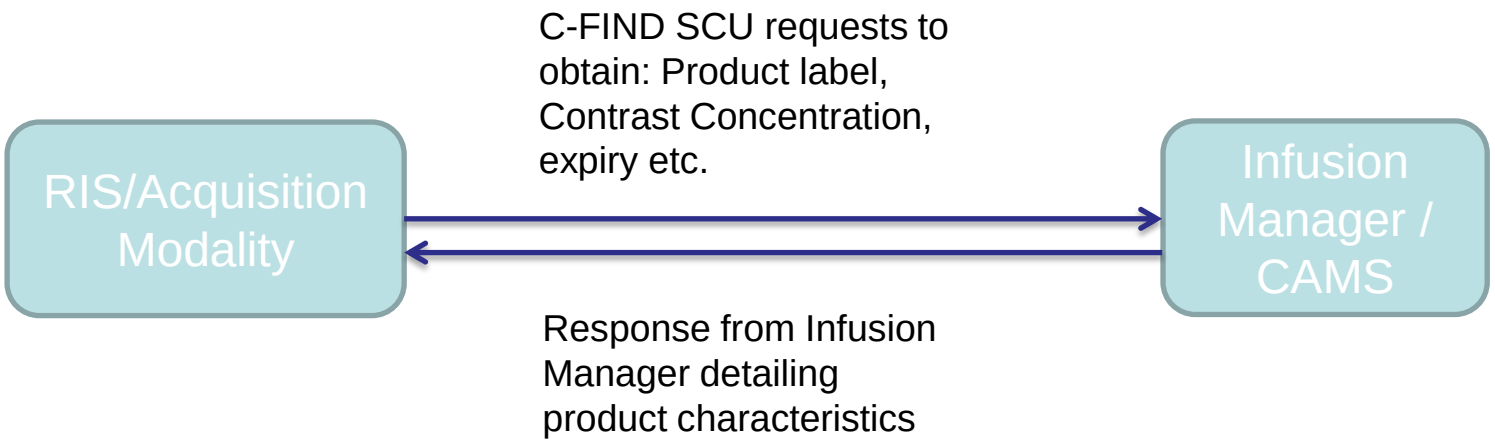
- Prior to Contrast Administration, the Infusion Manager could query the Hospital Medication Management System to check if the Contrast-Media substance has been approved.

- Very Useful when dealing with “With Contrast Studies” especially when the patient has known Contrast-Allergy history or CIN risks.

Using Substance Administration Query Service Class



Product Characteristics Query Model



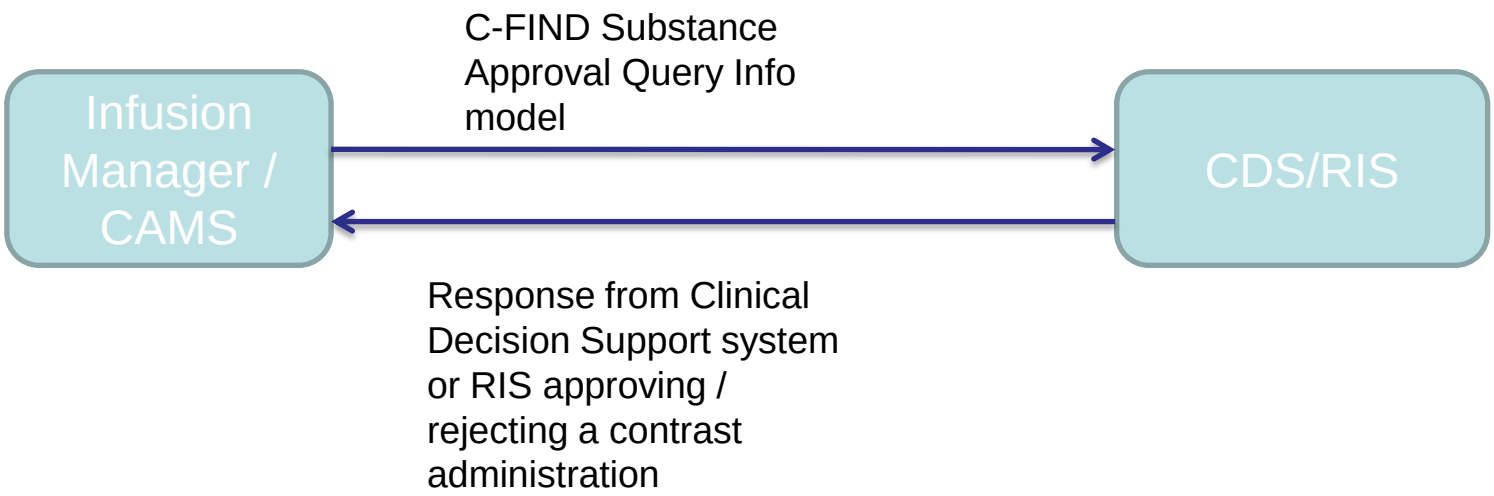
Product Characteristics – Use cases

- Obtain the active ingredient, concentration, or other parameters of a contrast agent for inclusion in the image SOP Instances created during use of the agent, or for setting up image acquisition parameters

- Obtain the size parameters of a device (e.g., a catheter) for use in calibrating images that show that device

- Obtain a network reference for an online copy of the “product label” (regulated prescribing and use data) for a contrast agent or device.

Substance Approval Query Model



Conclusions

- As the Contrast Injector devices are bettering in being able to communicate to the hospital information systems, various gaps that exists today. Some of the Gaps in radiology that could be closed:
  - A standard, reliable way of "structured reporting" of contrast administration data to Archive Managers, Dictation/Reporting Systems, RIS systems is possible.
  - Subscription Based Services: Using UPS, helps close gaps between Infusion-Manager and Acquisition-Systems, Reporting Systems, Contrast-Media-Protocoling systems, by subscribing to receive data from Infusion Manager

Conclusions

- Usage of Substance Administration Query (SAQ) model benefits in better data integrity and enhances workflow.
- Substance Approval Module, part of SAQ greatly improves Patient Safety

Thanks

Kevin O'Donnell,
Co-Chair, DICOM Committee
for valuable inputs, guidance!

http://dicom.nema.org/

http://www.IHE.net/

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Thank you for your attention !