VCUHS Perspective NPCR-MERP

CDC-NPCR
Facilitate & Guide
Model Development

Virginia Commonwealth University Health System (VCUHS)
Implement & Test Model

Virginia Cancer Registry (VCR)
Monitor Model Development/
Pilot Central Registry Automation

VCUHS Role in NPCR-MERP

- Serve as a site for Pilot Implementation of the Model
  - Implement the capture of electronic data from several commonly available data sources into the hospital cancer registry

  - Implement the model for automated electronic transfer of EMR data from the hospital to the central cancer registry

NPCR-MERP: How is it different?

- MERP focuses on automation initiated at the hospital level

- MERP includes attention to automated capture of key *required* elements beyond case finding

- MERP also includes capture of *other* data elements related to cancer surveillance

- MERP is based on the intellectual capital of the registrar for
    - building the registry function business model
    - and optimizing the system's efficiency

VCUHS Registry Focus

- ## Case ascertainment
  - Timeliness (4-6 month lag)
  - Efficiency (personnel effort expended in downloading data, screening large volumes of data and reports, re-entry of electronic data, materials handling and disposal)
  - Accuracy (transcription errors)

- ## Initial Treatment
  - Efficiency (review of multiple sources, data entry, transcription errors)
  - Completeness/validity (initial planned versus received)

VCUHS Registry Focus

- Follow Up
  - Efficiency (man hours of data entry and logging into various multiple sources for follow up)
  - Completeness (currently dependent on either death index, contact with MDs, claims-based utilization)
  - Issues of HIPAA

- Diagnostic Work Up
  - Capture of clinical laboratory tests
  - Improved information and potential to capture more complete and useful data
  - Currently capture tests not results (i.e. PSA *performed* not PSA *value*)

VCUHS Registry Focus

- Quality Control/ Quality Improvement
  - Efficiency: Would allow registrars to *be* registrars!
  - Validity: Multiple sources could be compared and assessed for comparability of data.
  - Accuracy: Reduction in transcription and translation errors.
  - Quality: Increased ability to focus on assessing completeness and data quality in the registry.

How MERP might impact a registrar's daily function

- Enhance CTR analytic function

- Diminish clerical/paper work

- Increase opportunity for validation through automated integration of data from multiple sources

How MERP might impact a registrar's daily function

- Improve timeliness, completeness and validity of many data elements
  - Automate flow of case finding
  - Potential for real time case ascertainment

- Opportunity to capture additional important data elements without increasing the registrar's workload
  - Follow up
  - Clinical diagnostic parameters
  - Subsequent therapy
  - Recurrence

The MERP process is applicable to all hospitals even if the EMR is not fully integrated for all sources

- The primary data sources identified by MERP at the hospital level are currently being used in all hospitals

- The model is developed in segments that permit implementation in a stepwise fashion.

Focus is on Common Electronic Data Sources available in a standard format

- Claims: UB92 and CMS 1500

- Surgical pathology synoptic &/or text reports

- Clinical laboratory reports

- Commercial vendor linkages to SSDI and other public sources

Focus is on Standardized Electronic Data Elements and Languages

- Codes
  - SNOMED CT
  - ICD-9, CPT
  - LOINC (translate clinical laboratory tests for standardized capture and upload)

- Languages/protocols
  - HL7 (standard protocol used for data review and upload into registry product)
  - CAP Synoptic Reports (standardized information on histology and staging)

The association between the VCUHS EMR Components and NAACCR Standards

NAACCR STANDARD	MCCIS Claims	Pathology	Radiation Oncology	Surgery	Oncology Clinic	Accurint
Demographic	●	●				
Patient-Confidential	●	●				
Cancer Identification		●				
Stage/Prognostic Factors	●	●				
Text-Diagnosis		●				
Treatment - 1st Course	●		●	●	●	
Treatment - Subsequent & Other	●		●	●	●	
Text-Treatment			●	●	●	
Hospital-Specific	●		●	●	●	
Other-Confidential	●	●		●		
Hospital-Confidential	●					
Follow-up/Recurrence/Death	●					●
Text-Miscellaneous						
Special Use						
Edit Overrides/Conversion						
History/System Admin						
Record ID						

VCUHS Registry Aims

- Develop HL7 protocol for translation and transmission of required data from hospital sources for capture and upload by registry software.
  - Protocols will provide optimal transportability and generalizability.
    - Will require modest modification (data mapping) for use in other hospital systems.

- Implement registry software (CNExT and CAS) with capacity for automated screening and upload of standardized data elements
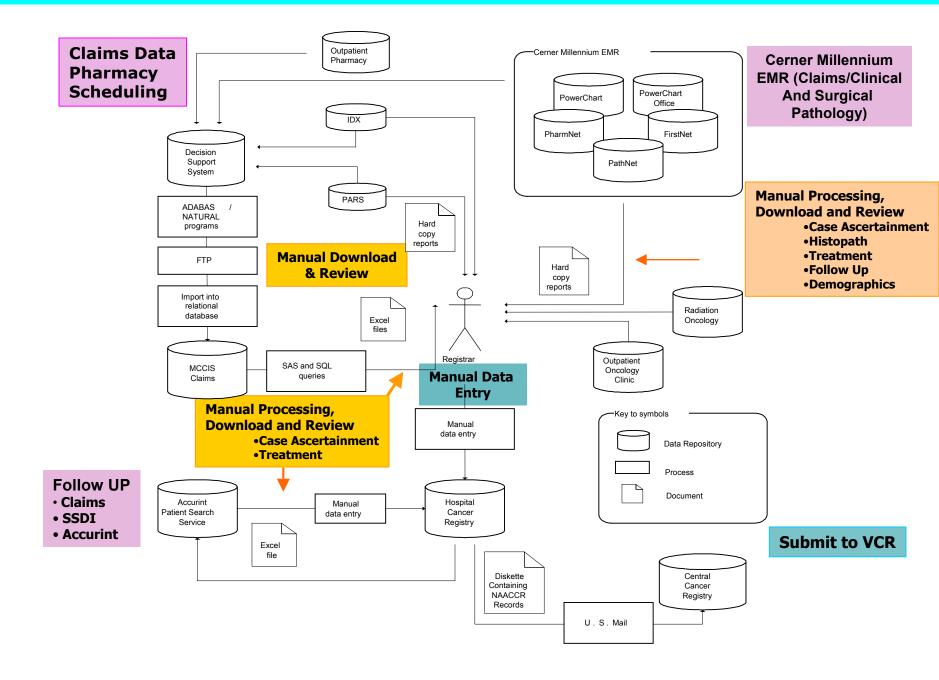
VCUHS Registry Aims

- Work with vendor (CNET Solutions) to broaden range of data elements captured to include:
  - **Treatment (surgery, chemotherapy and radiation therapy)**
  - **Direct upload of follow up information and updated demographic and contact data**
  - **Additional data elements**
    - **Clinical laboratory data**
    - **Comorbidity**

VCUHS Registry Aims

- Develop secure HL7 protocol for transfer of data from hospital to the central registry (VCR)
  - Protocol will be PHIN-compliant, generalizable and transportable
  - Schedule for data transfer may be variable

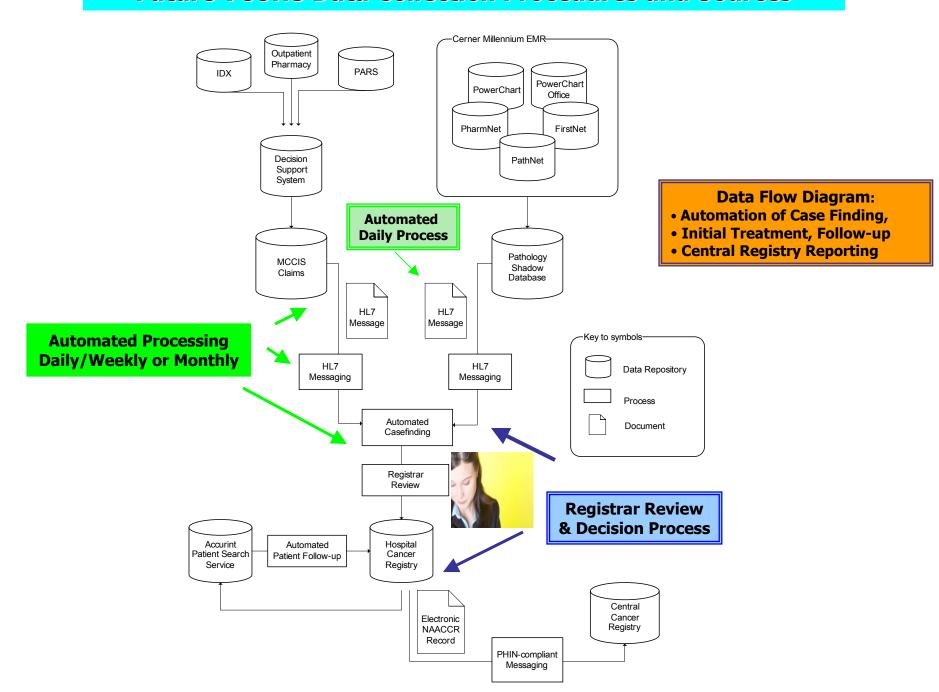# Data Flow Diagram: Current VCUHS Registry Data Collection Procedures and Sources
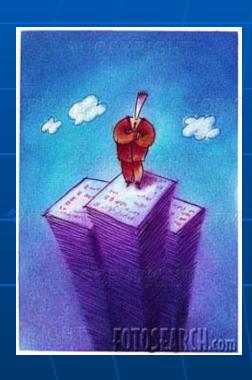
Future VCUHS Data Collection Procedures and Sources

Data repositories: IDX, Outpatient Pharmacy, PARS

Cerner Millennium EMR: PowerChart, PowerChart Office, PharmNet, FirstNet, PathNet

Decision Support System → MCCIS Claims

Pathology Shadow Database

Automated Daily Process

HL7 Message, HL7 Message

Automated Processing Daily/Weekly or Monthly

HL7 Messaging, HL7 Messaging

Automated Casefinding → Registrar Review → Hospital Cancer Registry

Accurint Patient Search Service → Automated Patient Follow-up → Hospital Cancer Registry

Hospital Cancer Registry → Electronic NAACCR Record → PHIN-compliant Messaging → Central Cancer Registry

Data Flow Diagram:
- **Automation of Case Finding,**
- **Initial Treatment, Follow-up**
- **Central Registry Reporting**

Registrar Review & Decision Process

Key to symbols:
- Data Repository
- Process
- Document

Current Status of VCUHS in MERP

- HL7 Messages for capture of claims data (ADT) and pathology text (ORU) for case finding successfully implemented and functioning with CNExT and the CAS

- Sequence diagram and Class diagram for model of registry function at VCU completed and available online for comment

- Developing tables for use in capture of treatment from claims data and discharge summary text data

- Developing protocol and HL7 message for selected clinical laboratory results
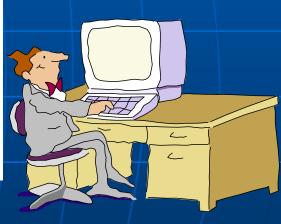
Simplification by Automation


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GREEN ST^^BIG CITY^VA^145190000^USA^^^041^^|041|(123)555-1234|||M|||123456789|||||||||||Y|
PV1|001|A|||||||||||||||||||||||||||||||||||||||||
DG1|001||174.9^MALIGN NEOPL BREAST NOS^ICD9^^^|00000000||||||||||NON STAFF PHYSICIAN,NON S||||
DG1|002||174.9^MALIGN NEOPL BREAST NOS^ICD9^^^|00000000|||||||||DOCTOR NAME HERE||||
DG1|003||V58.81^FIT/ADJ VASCULAR CATHETR^ICD9^^^|00000000||||||||||DOCTOR NAME HERE||||
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PR1|005||36535^CPT^REMOVAL OF ACCESS PORT^^^||00000000|P|||||DOCTOR NAME HERE|||
PR1|006||85.21^PR1^LOCAL EXCIS BREAST LES^^^||20010216|P|||||DOCTOR NAME HERE|||
PR1|007||86.05^P01^SKIN INCIS & FB REMOVAL^^^||20010216|P|||||DOCTOR NAME HERE|||
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Automated Capture
Of Electronic Cancer Surveillance
Data Via HL7 Message

Before
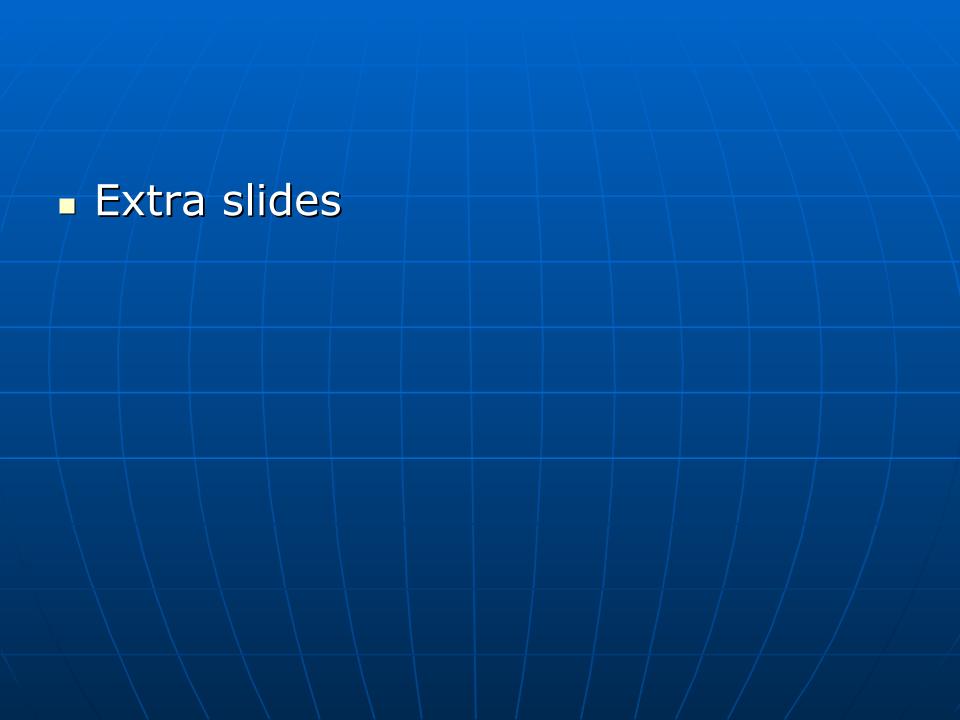
After

Next Steps at VCU for MERP

- Integrate additional data sources into HL7 message (discharge summary, clinical pathology, follow up information)

- Continue collaboration with CNET to permit automation of capture of treatment, follow up, and laboratory data

- Begin development of secure HL7 transfer protocol to VCR

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- Extra slides
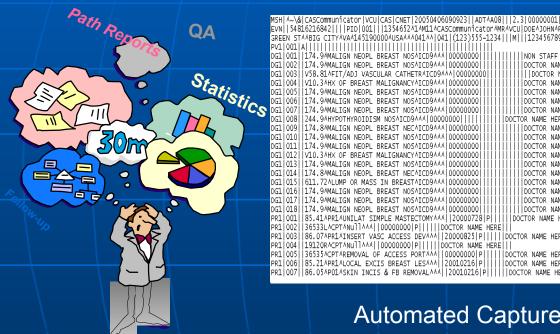
Present VCUHS Registry Data Collection Procedures and Sources

- Utilization of electronic sources (claims, clinical and surgical pathology and other sources) for case ascertainment, treatment reporting and follow up.

- Lack of compatibility with registry software requires printing or download and manual data entry

- Inefficiencies (manual review of large numbers of path reports, manual data entry and risk of transcription errors)

Simplification by Automation

Future VCUHS Registry Data Collection Procedures and Sources

- Automate the process of obtaining data from these electronic sources and upload directly into the registry

- Will continue to have manual review by registrar prior to acceptance of most data

- Frees CTR for case ascertainment of complex cases, perform validation and quality improvement studies.

- The MERP will build on the intellectual capitol of the registrar in building the business model for registry function and in optimizing the efficiency and effectiveness of the system
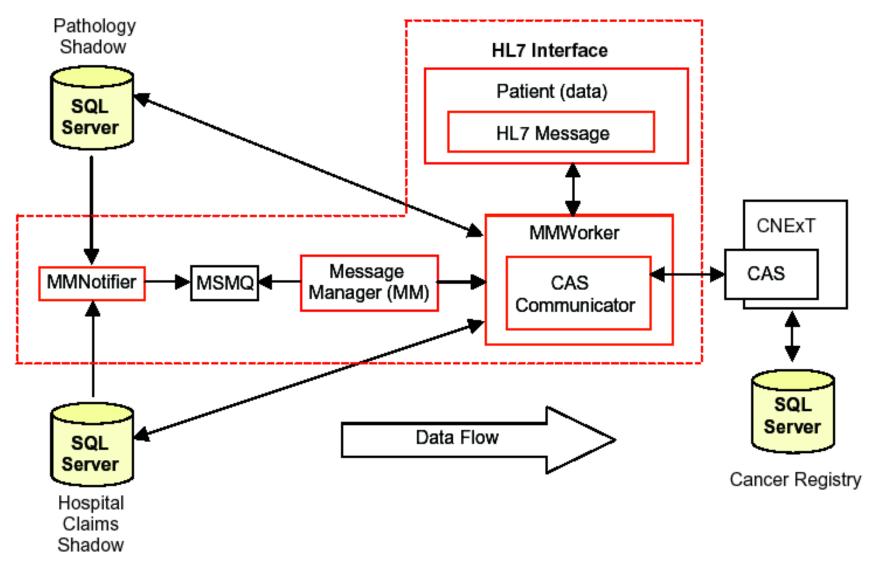
Figure 1: Block Diagram of the Proposed State

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PV1|001|A|||||||||||||||||||||||||||||||||||||||||||||||||||
DG1|001||174.9^MALIGN NEOPL BREAST NOS^ICD9^^^|00000000|||||||||||NON STAFF PHYSICIAN,NON S||||
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Example ADT A08 (HL7) Message

NPCR-MERP: How is it different?

The majority of current e-registry projects have focused on automated reporting from clinical pathology labs and data capture at the central registry level

MERP focuses on automation initiated at the hospital level

- Improving timeliness, accuracy, and efficiency of hospital reporting will impact the central registry

- Automated electronic reporting from the hospital provides the opportunity to meet changing registry standards

- Offering extensibility of data collected as new information becomes relevant (comorbidity, genetic data, recurrence, subsequent Rx, values for diagnostic markers longitudinally)

NPCR-MERP: How is it different?

The majority of e-registry projects to date have focused on case finding/ascertainment

MERP includes attention to automated capture of key *required* elements beyond case finding including:

- Histopathology
- Staging
- Initial treatment
- Follow up (vital status)

NPCR-MERP: How is it different?

MERP also includes capture of *other* data elements related to cancer surveillance

- Improving accuracy and efficiency of data on initial & subsequent treatment (specific doses)

- Improved capture of follow up data (recurrence)

- Values for selected diagnostic and prognostic markers

Class Diagram of HL7 Interface for Virginia Commonwealth University

CASQ : MSMQ

MMNotifier.exe

MessageManager
- myCASPortNumber : int
- myIPAddressOfCAS : string
- myIsPollingFlag : bool
- myLogMessagesFlag : bool
- myMSMQ : MSMQ
- myMSMQMessage : string
- myMSMQThread : Thread
- myUseGUIFlag : bool
- +MessageManager()
- +isPolling()
- +pollMSMQ()
- pollThread()
- sendStopMessage()
- stopPolling()

MMWorker
- myCASComm : CASCommunicator
- myMRNList : SqlDataReader
- messageNumber : int
- myACKMesage : string
- myHL7Message : string
- myMessageSource : string
- myNumOfErrors : int
- myStopFlag : bool
- isBufferLocked : bool
- numOfWorkerThreads : int
- +MMWorker()
- +markMessageAsSent()
- +sendMessages()
- +setCASCommunicator()
- +logMessage()
- +buildADTMRNList()
- +sendBufferedMessages()
- +sendORUMessages()
- +updateMessage()
- +getMRNList()
- +run()
- +isBufferEmpty()
- +parseMessage()

<< creates >>
<< creates >>

Patient
- myADTMessage : ADTMessage
- myORUMessage : ORUMessage
- myDiagnosisDR : SqlDataReader
- myHospDemoDR : SqlDataReader
- myProcedureDR : SqlDataReader
- myPathReport : SqlDataReader
- myMRN : int
- myMessageIDList : MessageID
- myORUMessage : ORUMessage
- myFirstName : string
- myLastName : short
- myMessageTypeID : int
- +Patient(in MRN : int)
- buildDiagnosisDR()
- buildProcedureDR()
- buildHosDemDR()
- getMRN()
- getHospdemDR()
- getProcedureDR()
- getDiagnosisDR()
- getMessageList() : ArrayList
- setMessageIDList()
- hasNewData()
- buildORUMessage()
- buildADTMessage()
- buildPathReport()

<< Retrieves HL7 Message >>

MessageID
- myDXCode
- myCPAN
- myMRN
- myTableSouce
- myType
- myVisDate
- +MessageID()
- +getDXCode()
- +getCPAN()
- +getMRN()
- +getTableSource()
- +getVisDate()

CASCommunicator
- myACKMessage : string
- myACKMRN : string
- myClientThread : Thread
- myFailFlag : bool
- myIPAddress : string
- myLastMessageSent : string
- myNetworkStream : NetworkStream
- myMRN : int
- myNumberRejected : int
- myNumberSent : int
- myPortNumber : int
- myTCPClient : TCPClient
- myTimeLimit : int = 5
- +CASCommunicator()
- +close()
- +connect()
- +didMessageFail()
- +disconnect()
- +getACKMessage()
- +getLastMsgSent()
- +getNumberRejected()
- +getNumberSent()
- +parseACK()
- +receive()
- +runClient()
- +send()
- +sendToCAS(in aPatient : Patient)
- +wasMessageSent()

CASServer
- myAcknowledgementCode
- myNetworkStream
- myPortNumber
- myServerThread
- mySocket
- +CASServer()
- +close()
- +createHL7ACK()
- +getMRN()
- +parseMessageNumber()
- +runServer()

CAS.exe

Other HL7 Messages...

HL7Message
- -myEventType : string
- -myMessageType : string
- #mySegmentType : string
- #myMessageIDList : MessageID
- #myIsEmptyFlag : bool
- -numberOfHL7Messages : int
- +HL7Message()
- +addSegment()
- +ToString()
- +isEmpty()

ADTMessage
- +ADTMessage(in aPatient : Patient, in eventDate : string)
- -parseDiagnoses()
- -parseProcedures()

ORUMessage
- +ORUMessage(in aPatient : Patient, in eventDate : string)

Field
- -myListOfComponents : ArrayList
- -myListOfComponentListIndex : ArrayList
- -myNumberOfComponents : int
- -myFieldDelimieter : string = |
- -myFieldRepeatDelimiter : string = ~
- +Field(in comValue : string, in cleanIt : bool)
- +getNumberOfRepetitions()
- +insertAt()
- +isEmpty()
- +ToString()

Component
- -myComponentValue : string
- -mySubComponentList : ArrayList
- -componentDelimiter : string = ^
- -subComponentDelimiter : string = &
- -subCompSepEscapeChar : string = \T\
- -repetitionSepEscapeChar : string = \R\
- -componentSepEscapeChar : string = \S\
- -startHighlighting : string = \H\
- -endHighlighting : string = \N\
- -escapeCharacter : string = \E\
- -fieldSepEscapeChar : string = \F\
- -hexData : string = \Xdddd
- -locallyDefinedEscapeSeq : string = \Zdddd
- +Component(in theValue : string, in cleanIt : bool)
- +addSubComponent()
- +getComponentValue()
- +getNumberOfSubComponents()
- +insertSubComponentAt()
- +insertSubComponenetAt()
- +setComponenetValue()
- +createMod11CheckDigit()
- +ToString()
- +lookForDegree()
- +lookForMiddleInitial()
- +lookForSuffix()
- +toDataTypeCS()
- +clean()
- +toDataTypeDT()
- +toDataTypeTM()
- +toDataTypeTS()
- +toDataTypeXAD()
- +toDataTypeXPN()
- +toDataTypeXTN()

Segment
- -myNumberDiscreteFields : int
- #myFieldList : Field
- -prevSegmentID : int
- -segmentNumber : int
- +Segment(in numFields : int, in charSegmentID : string)
- +setMySegmentID()
- +ToString()

Other Segments...

PID
- -myExpireDate : string
- -myIsAliveFlag : string
- -myMRN : int
- -myExpireCode : string = 20.0
- +PID()
- +setAddress()

EVN
- -myDateOfEvent : string
- +EVN(in dateOfEvent : string)
- +createEVNSegment()

PV1
- -myPatientClass : string
- +PV1(in patientClass : string)

DG1
- +DG1()

PR1
- +PR1()

MSH
- -myEventType : string
- -myMessageType : string
- +MSH(in msgType : string, in eventType : string)
- -createSegment()

OBX
- +OBX()

OBR
- +OBR()

Sequence of Events
1) The Message Manager continuously polls the MSMQ for a message from the MMNotifier.exe
2) The Message Manager finds a Claims message in the MSMQ
3) An MMWorker object is created on it's own thread to process this task
4) The MMWorker creates it's own CAS Communicator object.
5) Unsent messages from the previous task are sent
6) A list of MRNs is built from the Claims database
7) A Patient object is created based on the first/next MRN
8) The Patient object creates an ADT Message object
9) The CAS Communicator pulls the ADT Message out of the Patient object
10) The CAS Communicator sends this message to the CAS.exe
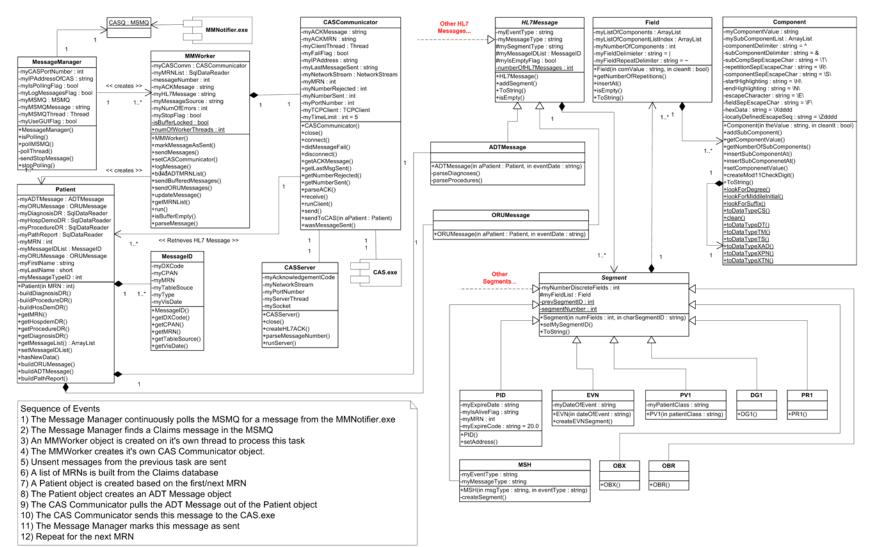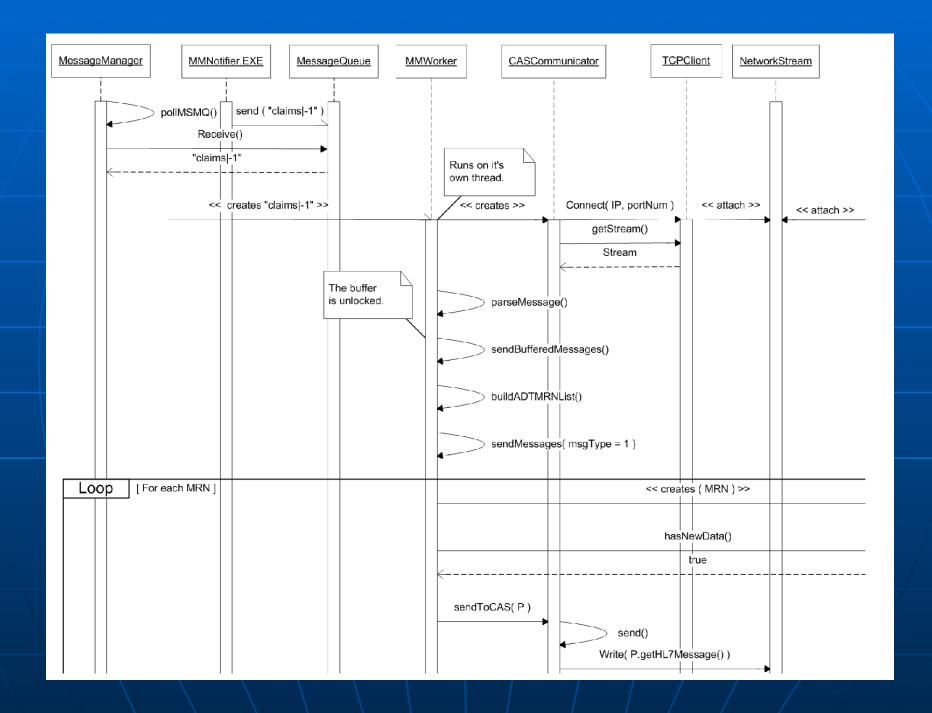11) The Message Manager marks this message as sent
12) Repeat for the next MRN

Figure 2: Class Diagram

Potential Vendor collaborations

- C/NET Registry Software's Case Ascertainment System (CAS)
  - Automation of screening HL7 messages for selected text and codes for case ascertainment
  - Upload into Registry Suspense file with opportunity to upload as case if approved by registrar
  - Matches with series of SNOMED CT and ICD-9 codes & other selected text

Potential Vendor collaborations

Accurint

- Searches multiple public and limited access databases for information on individuals
- Includes SSDI searches
- Provides updated data on demographics as well as vital status
- HIPAA Compliant methods of data sharing
- Advantage of searching US population databases for lost to follow up
- Opportunity to develop automated capture via electronic reporting file

VCUHS Registry Deliverables

- Develop protocols to translate required elements from a variety of electronic sources (SQL, flat files) into an HL7 message for capture & upload by registry software.

- Translation protocols will be developed to provide optimal transportability and generalizability.
  - Will require modest modification for use in other hospital systems.

- Implement capture & translation of selected data elements from common data sources into standard messaging language (HL7) and vocabulary (LOINC/SNOMED CT).

- Develop PHIN-compliant protocol for "real-time" delivery of cases to the Virginia Cancer Registry

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MSH|^~\&|CASCommunicator|VCU|CAS|CNET|20050510115923||ORU^R01|1234567_0510055923|P|2.3|00000002|
PID|001|||1234567^5^M11^^MR^||Jane^Mary^^^^^L|||||||||||||||||||||||||||||
OBR|001|||123456789^^^^^||||||||||||||||||||||||||||||||||||||||
OBX|001|TX|123456^^^^^^||SURGICAL PATHOLOGY GROSS DESCRIPTION
The specimen is received fresh in a single container labeled "right breast tissue" and consists
of a 1700 gram modified radical mastectomy specimen including an axillary tail. The specimen has
overall dimensions of 40.0 x 20.0 x 7.5 cm.  There is an elliptical brown-tan centrally located
portion of skin which is 22.0 x 14.0 cm. and a centrally located raised nipple.  The deep
surgical margin is inked black and multiple serial sections through the breast parenchyma reveal
a predominately fatty and fibrous breast parenchyma.  within the breast parenchyma are
multifocal areas of both well-encapsulated masses.  There is also a stellate griddy area of
nodularity grossly suggestive of carcinoma.  This stellate lesion is 1.8 x 1.5 x 1.5 cm. and 4.0
cm. from its closest (deep) surgical margin.  Approximately it appears to be in the mid superior
aspect of the mastectomy specimen.  The well-encapsulated masses are scattered throughout the
breast parenchyma and have a lobulated cut surface grossly suggestive of fibroadenomas.  These
nodules are scattered throughout the breast parenchyma and
range from 2.0 to 0.4 cm. in their greatest dimensions.  The remainder of the breast parenchyma
is predominately fatty.  There are no additional lesions, nodules or masses.  Sectioning through
the attached axillary dissection reveals multiple pink to red-tan lymph nodes ranging from 2.5
to 0.2 cm. in their greatest dimension.  All lymph nodes are submitted.
SURGICAL PATHOLOGY SUMMARY OF SECTIONS 1C-1E - sections of stellate lesion 1F - deep surgical
margin closest to stellate lesion 1G-1J - representative sections of nodules within breast
parenchyma from medial to lateral aspect 1K-1P - axillary lymph nodes
SURGICAL PATHOLOGY MICROSCOPIC INTERPRETATION Carcinoma, infiltrating ductal type, modified
Bloom-Richardson grade II of III, of right breast, mastectomy Multiple fibroadenomas of right
breast. Proliferative fibrocystic change of right breast.
Right axillary lymph nodes (13), no tumor identified.||||||F||||||
```
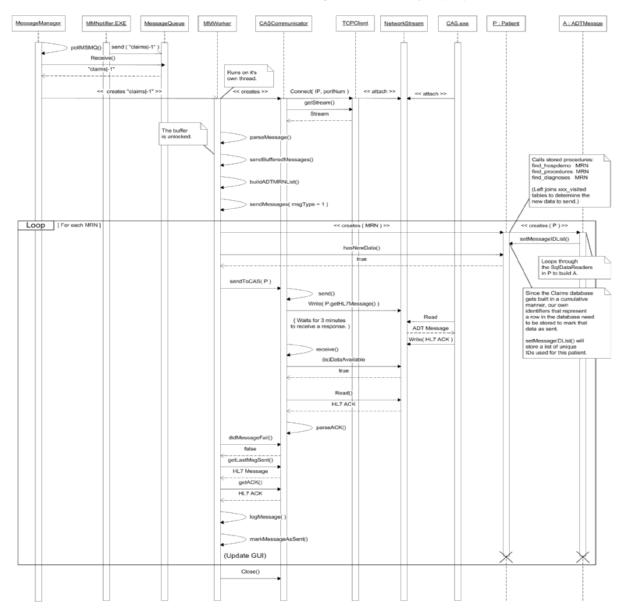
Example ORU R01 Message

Figure 3: Sequence Diagram

Focus is on Common Data Elements available in a standard format

- ICD-9 Codes from claims data for:
  - *Case identification*
  - *Follow up (vital status and recurrence)*
  - *Initial Treatment Details*
  - Subsequent Treatment Details
  - Comorbidity

Focus is on Common Data Elements available in a standard format

- CPT Codes from Claims data for:
  - *Initial Treatment*
  - Subsequent Treatment

- SNOMED CT Codes from Surgical Pathology Reports and synoptic report data for:
  - *Case Identification*
  - *Histopathology details*