

1 Laboratory Workflows

The workflows are designed to support the following types of data exchanges:

- Electronic Medical Records (EMR) systems can send an electronic lab order to a laboratory information system (LIS).
- A LIS can send lab results electronically to an EMR
- For more information on exemplary implementations, please contact the LIS COP.

1.1 Lab Test Ordering

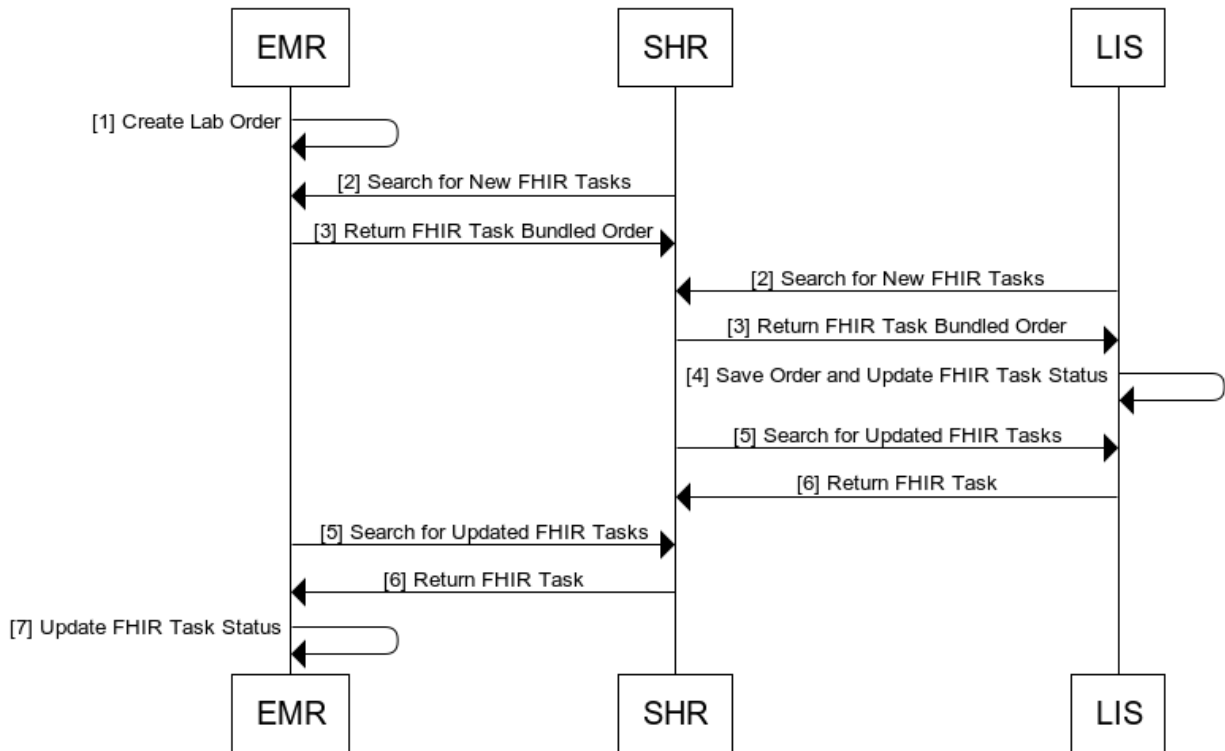
Electronic Medical Records (EMRs) systems can send an electronic lab order to a laboratory information system (LIS).

Standards	• FHIR R4 search on Task, DiagnosticReport, ServiceRequest or Patient resources • FHIR R4 bundle search response • FHIR R4 Workflow
Assumptions and Prerequisites	• The EMR system is a trusted application known by the LIS and there are mutual certificates established over SSL/TLS • The PoS and LIS systems will implement a scheduled service to pull updates
Actors	• EMR - The electronic medical record system that captures the patient and order information and sends the electronic order to the LIS • LIS - The laboratory information system that pulls order information, processes orders, updating statuses and generating results sets

1.1.1 Interaction Description

The following sequence diagram below shows the steps that occur during this transaction.

Lab Ordering



www.websequencediagrams.com

Source for sequence diagram: websequencediagrams

#	Interaction	Data	Transaction Options
1	Create Lab Order	The order save generates a FHIR R4 Task Resource (see example here)	

2	Search for New FHIR Tasks		FHIR R4 Search for Tasks with status = requested for which the owner is the LIS where the order is requested
3	Return FHIR Task Bundled Order	FHIR Task bundled order consists of a FHIR R4 Task Resource and a referenced FHIR R4 Patient Resource (example). Task status is aligned with the FHIR workflow communication pattern found here	FHIR R4 bundle search response (example)
4	Save Order and Update FHIR Task Status	FHIR R4 Task Resource Status is updated locally to either <i>rejected</i> or <i>accepted</i> . A FHIR R4 ServiceRequest Resource (example) is created for order processing with a reference to the associated Task. EMR test requests and LIS orders are matched based on LOINC codes.	
5	Search for Updated FHIR Tasks		FHIR R4 Search for Tasks belonging to the EMR which were updated on or after last check
6	Update FHIR Task Status	FHIR task status updated locally	

1.2 Lab Results Reporting

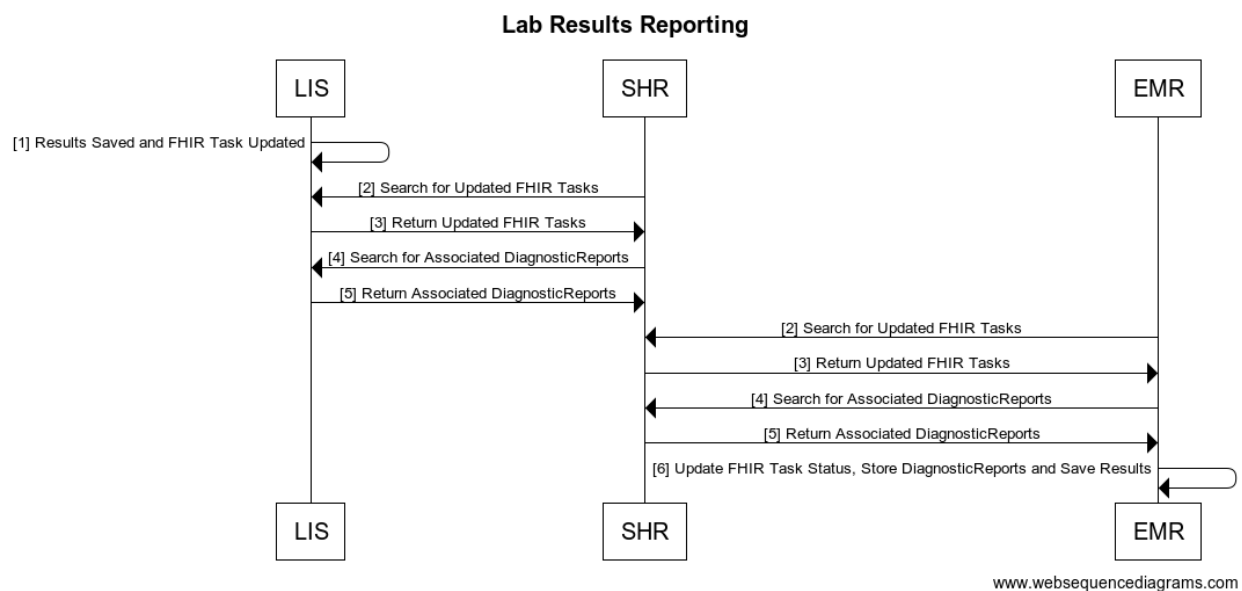
A laboratory information system (LIS) can send lab test results to an Electronic Medical Record (EMR) system.

Standards	FHIR R4 Workflow
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	- FHIR R4 search on Task, DiagnosticReport, ServiceRequest or Patient resources - FHIR R4 bundle search response
Assumptions and Prerequisites	- The EMR system is a trusted application known by the LIS and it is registered - The EMR and LIS systems will implement a scheduled service to pull updates
Actors	- EMR - The point-of-service electronic medical record system that captures the patient and order information and sends the electronic order to the LIS - LIS - The laboratory information system that pulls order information, processes orders, updating statuses and generating results sets

1.2.1 Interaction Description

The following sequence diagram below shows the steps that occur during this transaction.



Source for sequence diagram: websequencediagrams

#	Interaction	Data	Transaction Options
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1	Results Saved and FHIR Task Updated	The results save generates a FHIR R4 DiagnosticReport Resource (example) with referenced FHIR R4 Observation resources (example) to store the results, and a reference to the associated Patient and Task Resource.	
2	Search for Updated FHIR Tasks		FHIR R4 Search for Tasks based on tasks for which the owner is the EMR, and which have a status 'completed'
3	Return FHIR Updated Tasks	FHIR R4 Task Resource with status 'completed' and reference to FHIR R4 DiagnosticReport	FHIR R4 bundle search response (example)
4	Search for Associated Diagnostic Reports		FHIR R4 Search for DiagnosticReports by UUID
5	Return Associated Diagnostic Reports	FHIR R4 DiagnosticReport Resource with	

6	Update FHIR Task Status, Store DiagnosticReports and Save Results		
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Appendix A

Laboratory Workflow FHIR Resources

Task Resource

Example Task Order FHIR Resource:

```
{
  "resourceType": "Task",
  "id": "88ffa7fb-0419-4097-8b45-24f0d843c5ea",
  "identifier": [
    {
      "system": "http://isantepius.org/ext/task/identifier",
      "value": "88ffa7fb-0419-4097-8b45-24f0d843c5ea"
    }
  ],
  "basedOn": [
    {
      "reference":
"ServiceRequest/ebf83ba0-9d3c-497f-9aa0-d839ec506202",
      "type": "ServiceRequest"
    },
    {
      "reference":
"ServiceRequest/73e96ecb-a78d-41c8-a55f-d9b90f759e5f",
      "type": "ServiceRequest"
    }
  ],
  "status": "requested",
  "intent": "order",
  "for": {
    "reference": "Patient/e14e9bda-d273-4c74-8509-5732a4ebaf19",
    "type": "Patient"
  },
  "encounter": {
    "reference":
"Encounter/7f5aabd9-6375-47c8-a8d6-30f219b6e2f1",
    "type": "Encounter"
  },
  "authoredOn": "2020-04-28T17:33:19+00:00",
  "owner": {
    "reference":
"Practitioner/f9badd80-ab76-11e2-9e96-0800200c9a66",
    "type": "Practitioner"
  }
}
```

}

Supported Elements

- **Task.id** - The logical identifier of the Task resource
 - **Task.status** - The current status of the Task, represented using states from [this state machine](#). The OpenMRS implementation supports *requested*, *accepted*, *rejected*, and *completed* states.
 - **Task.intent** - Represents the actionability of the **Task**. The current OpenMRS implementation supports only the *order* value for this element.
 - **Task.basedOn** - A reference to the **ServiceRequest** resource that represents the order that caused the creation of this **Task**.
 - **Task.encounter** - The healthcare event (e.g. a patient and healthcare provider interaction) during which this task was created
 - **Task.for** - The entity who benefits from the performance of the service specified in the task (e.g., the patient).
 - **Task.owner** -
-
- **Task.inputs** - Information needed for performing the **Task**.
 - **Task.outputs** - Information produced by performing the **Task**.

ServiceRequest Resource

Example Service Request:

```
{
  "resourceType": "ServiceRequest",
  "id": "73e96ecb-a78d-41c8-a55f-d9b90f759e5f",
  "status": "active",
  "intent": "order",
  "code": {
    "coding": [
      {
        "code": "790AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA"
      },
      {
        "system": "http://loinc.org",
        "code": "14682-9"
      },
      {
        "system": "urn:oid:2.16.840.1.113883.3.7201",
```

```

        "code": "790"
      }
    ]
  },
  "subject": {
    "reference": "Patient/e14e9bda-d273-4c74-8509-5732a4ebaf19",
    "type": "Patient"
  },
  "encounter": {
    "reference": "Encounter/7f5aabd9-6375-47c8-a8d6-30f219b6e2f1",
    "type": "Encounter"
  }
}

```

Supported ServiceRequest Elements

- **ServiceRequest.id**
- **ServiceRequest.status**
- **ServiceRequest.intent** - Whether the request is a proposal, plan, an original order or a reflex order.
- **ServiceRequest.code** - A code that identifies a particular service (i.e., procedure, diagnostic investigation, or panel of investigations) that have been requested.
- **ServiceRequest.subject** - On whom or what the service is to be performed.
- **ServiceRequest.requester** - The individual who initiated the request and has responsibility for its activation.
- **ServiceRequest.performer** - The desired performer for doing the requested service.
- **ServiceRequest.occurrence** - The date/time at which the requested service should occur.

DiagnosticReport Resource

Example Diagnostic Report

```

{
  "resourceType": "DiagnosticReport",
  "id": "93",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2020-04-28T17:33:36.163+00:00",
    "source": "#55t4lpDZF4q3TCZ0"
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns=\"http://www.w3.org/1999/xhtml\"><div
class=\"hapiHeaderText\"> Untitled Diagnostic Report </div><table

```

```

class=\ "hapiPropertyTable\ "><tbody><tr><td>Status</td><td>FINAL</td></tr><
/tbody></table></div>"
},
"identifier": [
  {
    "system": "https://isantepiusdemo.com/openmrs/ws/fhir2/",
    "value": "ebf83ba0-9d3c-497f-9aa0-d839ec506202"
  }
],
"status": "final",
"code": {
  "coding": [
    {
      "code": "1008AAAAAAAAAAAAAAAAAAAAAAAAAAAA"
    },
    {
      "system": "http://loinc.org",
      "code": "22748-8"
    },
    {
      "system": "urn:oid:2.16.840.1.113883.3.7201",
      "code": "1008"
    }
  ]
},
"subject": {
  "reference": "Patient/2"
},
"result": [
  {
    "reference": "Observation/92",
    "type": "Observation"
  }
]
}

```

Supported Elements

- **DiagnosticReport.id** - The logical identifier of the Task resource
- **DiagnosticReport.status** - The [status](#) of the DiagnosticReport. The OpenMRS implementation currently supports *preliminary*, *final*, *amended*, *canceled*, and *unknown* states.
- **DiagnosticReport.code** - The LOINC code that describes this report.

- **DiagnosticReport.category** - for the purposes of this initial request, this value will always have the value "LAB" using the system " <http://terminology.hl7.org/CodeSystem/v2-0074>".
- **DiagnosticReport.encounter** - a [Reference](#) the encounter this diagnostic report is part of.
- **DiagnosticReport.subject** - a [Reference](#) to the appropriate Patient resource.
- **DiagnosticReport.issued** - The date and time this report was made available to Providers.
- **DiagnosticReport.result** - A collection of [Reference](#) to the [Observations](#) that hold the results associated with this diagnostic report.

Observation Resource

Example Observation:

```
{
  "resourceType": "Observation",
  "id": "92",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2020-04-28T17:33:36.124+00:00",
    "source": "#xAVz0uUE6c3l42Za"
  },
  "identifier": [
    {
      "system": "https://isantepiusdemo.com/openmrs/ws/fhir2/",
      "value": "ebf83ba0-9d3c-497f-9aa0-d839ec506202"
    }
  ],
  "status": "final",
  "code": {
    "coding": [
      {
        "code": "1008AAAAAAAAAAAAAAAAAAAAAAAAAAAA"
      },
      {
        "system": "http://loinc.org",
        "code": "22748-8"
      },
      {
        "system": "urn:oid:2.16.840.1.113883.3.7201",
        "code": "1008"
      }
    ]
  },
  "subject": {
    "reference": "Patient/2"
  },
}
```

```
"valueQuantity": {  
  "value": 55,  
  "unit": "UI/L"  
}  
}
```

Supported Elements

- `Observation.id`
- `Observation.status`
- `Observation.encounter`
- `Observation.subject`
- `Observation.code`
- `Observation.value`
- `Observation.component`
- `Observation.component.code`
- `Observation.component.value`

Patient Resource

Example Patient:

```
{  
  "resourceType": "Patient",  
  "id": "e14e9bda-d273-4c74-8509-5732a4ebaf19",  
  "identifier": [  
    {  
      "id": "5981a256-d60c-44b1-beae-9bdd2cf572f8",  
      "use": "official",  
      "system": "iSantePlus ID",  
      "value": "10012R"  
    },  
    {  
      "id": "75a67d54-6fff-44d1-9c3e-2116c967b475",  
      "use": "usual",  
      "system": "Code National",  
      "value": "100000"  
    },  
    {  
      "id": "29447d21-3cd6-42a9-9ab2-79ebfa710a01",  
      "use": "usual",  
      "system": "ECID",  
      "value": "04d759e0-5d02-11e8-b899-0242ac12000b"  
    }  
  ]  
}
```

```

    }
  ],
  "active": true,
  "name": [
    {
      "id": "511275de-e301-44a3-95d2-28d0d3b35387",
      "family": "Mankowski",
      "given": [
        "Piotr"
      ]
    }
  ],
  "gender": "male",
  "birthDate": "1987-01-01",
  "deceasedBoolean": false,
  "address": [
    {
      "id": "d4f7c809-3d01-4032-b64d-4c22e8ecbbc",
      "use": "home",
      "country": "Haiti"
    }
  ]
}

```

Supported Elements

- Patient.id
- Patient.identifier
- Patient.active
- Patient.name
- Patient.gender
- Patient.birthDate
- Patient.deceased
- Patient.address

Transaction Responses

LIS Bundled New Task Sample Response

```
{
```

```
"resourceType": "Bundle",
"id": "fe3b5b50-efc2-43a8-b97c-cbba5d6d41e7",
"meta": {
  "lastUpdated": "2020-05-28T21:36:36.461+00:00"
},
"type": "searchset",
"total": 2,
"link": [
  {
    "relation": "self",
    "url":
"http://isantepiusdemo.com/openmrs/ms/Task/?owner=Practitioner%2Ff9badd80-ab76-11e
2-9e96-0800200c9a66&status=REQUESTED"
  }
],
"entry": [
  {
    "resource": {
      "resourceType": "Task",
      "id": "35348ea0-f623-41b1-9c8b-db4d344e0fb0",
      "identifier": [
        {
          "system": "http://isantepius.org/ext/task/identifier",
          "value": "35348ea0-f623-41b1-9c8b-db4d344e0fb0"
        }
      ],
      "basedOn": [
        {
          "reference": "ServiceRequest/e0899e26-0919-446c-bdcc-6d7cd55f8948",
          "type": "ServiceRequest"
        },
        {
          "reference": "ServiceRequest/361ad815-1727-4ede-b7c1-b1c0ea6c8041",
          "type": "ServiceRequest"
        }
      ]
    }
  }
]
```

```

    }
  ],
  "status": "requested",
  "intent": "order",
  "for": {
    "reference": "Patient/e14e9bda-d273-4c74-8509-5732a4ebaf19",
    "type": "Patient"
  },
  "encounter": {
    "reference": "Encounter/6d345747-929f-4c70-8bbc-8fd8abe4a591",
    "type": "Encounter"
  },
  "authoredOn": "2020-05-28T21:36:27+00:00",
  "owner": {
    "reference": "Practitioner/f9badd80-ab76-11e2-9e96-0800200c9a66",
    "type": "Practitioner"
  }
}
},
{
  "resource": {
    "resourceType": "Task",
    "id": "b0c03f74-a177-498c-b123-4d9d36b47f95",
    "identifier": [
      {
        "system": "http://isantepius.org/ext/task/identifier",
        "value": "b0c03f74-a177-498c-b123-4d9d36b47f95"
      }
    ],
    "basedOn": [
      {
        "reference": "ServiceRequest/803c303c-de65-48c6-8ab5-03f25e7f50fe",
        "type": "ServiceRequest"
      }
    ],

```

```

    {
      "reference": "ServiceRequest/bffc9ee3-2d86-4450-bf31-3445705ef37c",
      "type": "ServiceRequest"
    }
  ],
  "status": "requested",
  "intent": "order",
  "for": {
    "reference": "Patient/e14e9bda-d273-4c74-8509-5732a4ebaf19",
    "type": "Patient"
  },
  "encounter": {
    "reference": "Encounter/213a1234-ab79-42ef-9699-1df3b383e913",
    "type": "Encounter"
  },
  "authoredOn": "2020-05-28T21:36:33+00:00",
  "owner": {
    "reference": "Practitioner/f9badd80-ab76-11e2-9e96-0800200c9a66",
    "type": "Practitioner"
  }
}
}
]
}

```

Search Response: Completed Task with DiagnosticReport Reference

```

{
  "fullUrl": "https://fhir.openelisci.org:8443/hapi-fhir-jpaserver/fhir/Task/151",
  "resource": {
    "resourceType": "Task",
    "id": "151",
    "meta": {
      "versionId": "4",

```

```
"lastUpdated": "2020-05-28T03:22:32.921+00:00",
"source": "#v4wyVbADI5Lr1nEt"
},
"identifier": [
  {
    "system": "http://isantepius.org/ext/task/identifier",
    "value": "ac0d562f-7ad5-447c-acb0-3dd56b9bff94"
  },
  {
    "system": "https://isantepiusdemo.com/openmrs/ws/fhir2/",
    "value": "ac0d562f-7ad5-447c-acb0-3dd56b9bff94"
  }
],
"basedOn": [
  {
    "reference": "ServiceRequest/152",
    "type": "ServiceRequest"
  },
  {
    "reference": "ServiceRequest/153",
    "type": "ServiceRequest"
  },
  {
    "reference": "ServiceRequest/154",
    "type": "ServiceRequest"
  }
],
"status": "completed",
"intent": "order",
"for": {
  "reference": "Patient/110"
},
"encounter": {
```

```
    "reference":  
    "https://isanteplusdemo.com/openmrs/ws/fhir2/Encounter/e8d96a7a-2dc6-4ff8-a882-f97434ea969c",  
    "type": "Encounter"  
  },  
  "authoredOn": "2020-05-27T23:52:21+00:00",  
  "owner": {  
    "reference":  
    "https://isanteplusdemo.com/openmrs/ws/fhir2/Practitioner/f9badd80-ab76-11e2-9e96-0800200c9a66",  
    "type": "Practitioner"  
  },  
  "output": [  
    {  
      "valueReference": {  
        "reference": "DiagnosticReport/158",  
        "type": "DiagnosticReport"  
      }  
    },  
    {  
      "valueReference": {  
        "reference": "DiagnosticReport/160",  
        "type": "DiagnosticReport"  
      }  
    }  
  ]  
},  
"search": {  
  "mode": "match"  
}  
}
```