

Medexter Healthcare

**ACHIEVING SYSTEM
CONNECTIVITY BETWEEN
ACTIVITI BPMN PLATFORM
AND ARDENSUITE**

Hepatitis B in Pregnancy as an
Example

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Summary

The aim of this *how-to* instruction manual is to show how to configure Activiti Business Process Model and Notation (BPMN) service tasks so that they can execute Arden Syntax Medical Logic Modules (MLMs) on an [ARDENSUITE](#) Server by using the ARDENSUITE extension for Activiti.

Document Information

Target Audience

This instruction manual was created for Activiti and ARDENSUITE Server users and developers interested in creating Activiti BPMN workflows that use MLMs deployed on an ARDENSUITE Server.

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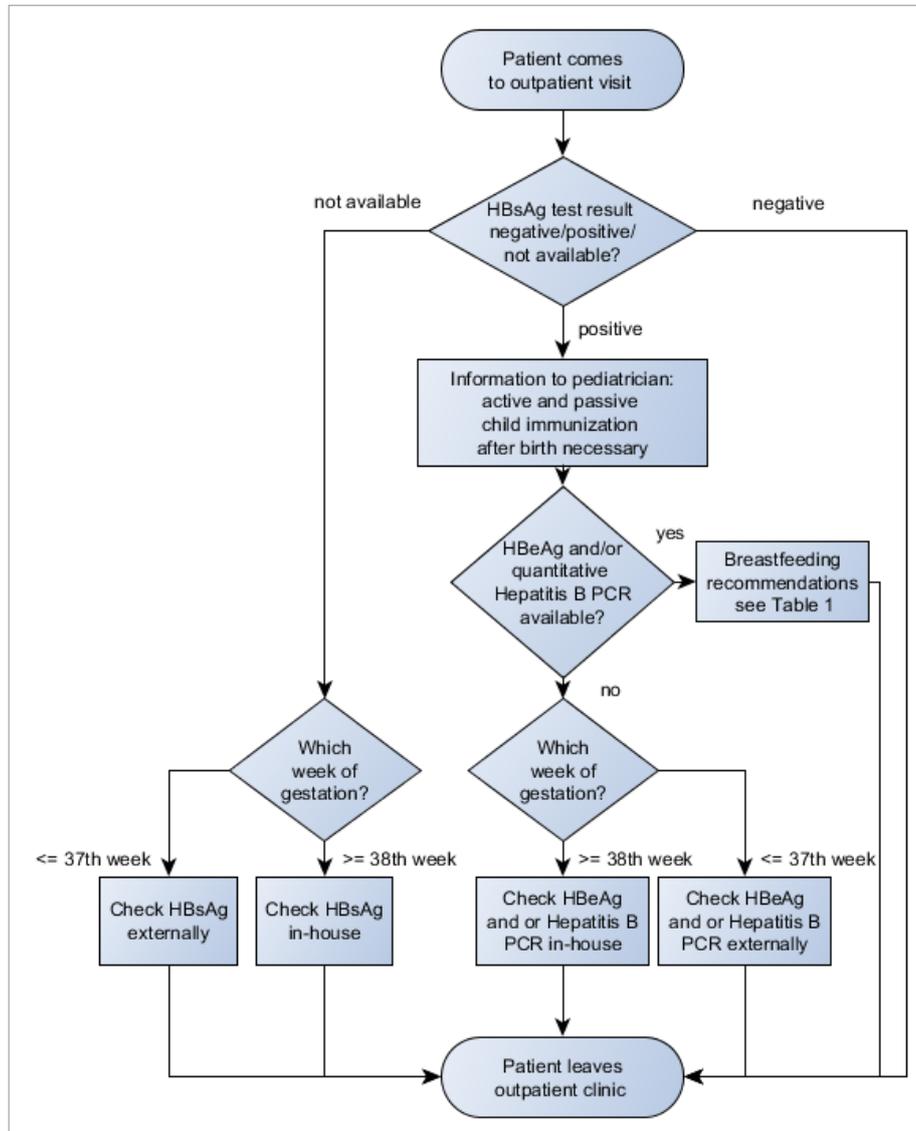
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Introduction

In this *how-to* instruction manual, we will guide you step-by-step in the creation of service tasks for the Activiti BPMN platform that call Arden Syntax Medical Logic Modules (MLMs) deployed on an ARDENSUITE Server. Throughout this *how-to*, we use part of a clinical guideline that addresses hepatitis B in pregnancy. In this clinical workflow, evidence-based instructions are provided on how to prevent mother-to-child transmission of hepatitis B during delivery (see figure below).



In this clinical guideline, whenever a patient comes for an outpatient visit, first a hepatitis B surface antigen (HBsAg) test result is checked. If the HBsAg test result is negative, no further actions are required and the patient may leave. If no test result is available, an HBsAg test is ordered either in-house or externally, depending on the current week of gestation. If the HBsAg test result is positive, it is assumed that the patient is hepatitis B positive, and the pediatrician is instructed to immediately

immunize the child after birth. In addition, the hepatitis B envelope antigen (HBeAg) or the hepatitis B polymerase chain reaction (PCR) test results are evaluated. If neither is available, an HBeAg and/or a hepatitis B PCR test are ordered either in-house or externally, again depending on the current week of gestation. If at least one of them is available, breastfeeding recommendations are made according to a (simplified) decision table (see table below).

Test results	Hepatitis-B-PCR > 10 ⁷ genomes/ml	Hepatitis-B-PCR ≤ 10 ⁷ genomes/ml	Hepatitis-B-PCR unknown
HBeAg positive	Do not breastfeed	Breastfeeding possible	Do not breastfeed
HBeAg negative	Do not breastfeed	Breastfeeding possible	Breastfeeding possible
HBeAg unknown	Do not breastfeed	Breastfeeding possible	N/A

For this *how-to*, the clinical workflow above was implemented as an Activiti BPMN workflow and service tasks in this workflow (the diamond shapes) were implemented in Arden Syntax MLMs. With this workflow as a use case, we show how Activiti BPMN service tasks can be configured so that they call MLMs which are deployed on an ARDENSUITE Server.

Requirements

For optimal use of this *how-to*, please make sure the following software is installed on your computer or accessible from your location:

- The ARDENSUITE IDE and ARDENSUITE Server with Database Connector
- A relational database management system (DBMS) (e.g., MySQL)
- Activiti BPMN 2.0 Platform (with Tomcat)
- Eclipse with Activiti Designer
- The ARDENSUITE Extension for Activiti

Note: Be aware that the ARDENSUITE Server and the tomcat server for Activiti, both require the [port 8080](#) by default. If you want both application servers to run on the same machine, setting a different port for one of the two servers in the corresponding server settings is required.

The ARDENSUITE IDE and ARDENSUITE Server with Database Connector

In case you do not have access to the ARDENSUITE IDE or the ARDENSUITE Server with Database

Connector yet, please contact us at support@medexter.com. A 30-day trial version of the ARDENSUITE can also be [downloaded here](#).

Relational Database Management System

The methods discussed in this *how-to* document are suited for any relational database that supports JDBC. For instruction in this document, we used [MySQL](#).

Activiti BPMN 2.0 Platform

In order to execute a BPMN process, it needs to be deployed on the Activiti BPMN 2.0 Platform. Processes are executed by the Activiti Engine, while the results and user interface is handled by the web application. At the moment, the ArdenSuite Extension for Activiti works only with version 5.22.0 of the Activiti BPMN platform. This version including the corresponding user guide (relevant chapters are 2.1 through 2.2) can be [downloaded here](#).

Eclipse with Activiti Designer

For the development of BPMN workflows in the Activiti Designer, the open source IDE Eclipse is required, which can be obtained [here](#). You will also need the Eclipse Designer, an Eclipse plugin for developing Activiti workflows. To install the Eclipse Designer plugin, follow [these](#) instructions (the relevant chapter is 12.1).

The ARDENSUITE IDE Extension for Activiti

In case you do not have access to the ARDENSUITE Extension for Activiti, please contact us at support@medexter.com.

Files

This *how-to* is accompanied by seven files: an SQL script [activiti_table.sql](#) that can be used to prepare the database tables used in the use case scenario; an Activiti BPMN workflow definition [HepatitisBInPregnancy.bpmn](#) that implements aforementioned clinical workflow; a java archive [MedexterBPMNExamples-1.0.jar](#) containing custom-built classes needed to execute the workflow; and four MLM files (extension [.mlm](#)) that correspond to the service tasks in the aforementioned clinical use case workflow:

- **BreastfeedDecision:** The MLM [BreastfeedDecision.mlm](#) implements the aforementioned table on breastfeeding decisions based on the HBeAg and/or PCR test results.

- **ReadHBsAgTestResult:** The MLM `ReadHBsAgTestResult.mlm` returns the HBsAg test result for a certain patient.
- **ReadHBeAgAndHBPCR:** The MLM `ReadHBeAgAndHBPCR.mlm` determines if there are any HBeAg or Hepatitis PCR test results available for a certain patient.
- **ReadGestationWeek:** The MLM `ReadGestationWeek.mlm` returns the gestation week for a certain patient.

NOTE: *The MLM files can be opened using any standard text editor or viewer, but in order to compile and upload the MLMs, the ARDENSUITE IDE and ARDENSUITE Server are required.*

Preliminaries

Before you can start with the actual *how-to* part of this manual, the database has to be created and MLMs have to be compiled and deployed on the ARDENSUITE Server before calls can be made to them.

Database Setup

The first step is creating a database (e.g., a [MySQL](#) database using [XAMPP](#) and [phpMyAdmin](#)). For the purpose of this *how-to*, a database called `activiti_testcase` should be created. With this *how-to*, you also received an SQL script (`activiti_table.sql`) that you can load and execute in order to automatically create and fill database tables.

After creating the database, a connection between the ARDENSUITE Server and the DBMS has to be established and configured in order for MLMs on the ARDENSUITE Server to retrieve data from the created database. To do this, we refer to the corresponding *how-to* document, which can be found [here](#).

Compiling and Uploading MLMs

Before an MLM can be called, it first needs to be compiled and uploaded onto the ARDENSUITE Server. To do this, we refer to the corresponding *how-to* document, which can be found [here](#). The *how-to* at hand requires you to compile and upload all accompanied MLMs.

Note: *If any changes you may make in the MLM result in a different response, please be aware that the `HepatitisBInPregnancy.bpmn` file has to be changed accordingly. Check the decision branches in the Activiti BPMN workflow, where the expected ARDENSUITE Server responses have to be set.*

Workflow Preparation

Since the clinical use case workflow utilizes several custom-built classes, these classes first need to be deployed. To deploy the classes, copy `MedexterBPMNExamples-1.0.jar`—which accompanies this document—to your `\webapps\activiti-explorer\WEB-INF\lib` and `\webapps\activiti-rest\WEB-INF\lib` folders of your Tomcat installation path. The table below shows the dependencies between Activiti service tasks and classes in this library:

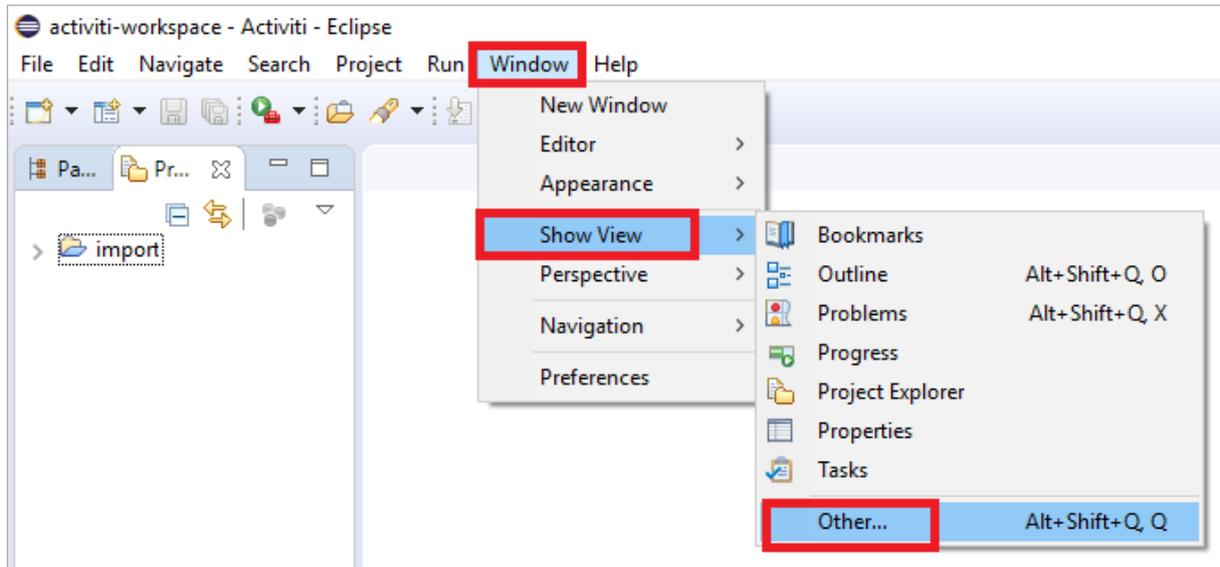
Activiti Service Task	Library
Convert input to JSON	<code>medexter.activiti.hepatitis.ambulance.ConstructJSON</code>
MLM: HBsAg test result	<code>medexter.ardensuite.extension.CallArdenSuiteServer</code>
MLM: HBeAg and/or quantitative Hepatitis B PCR test result	<code>medexter.ardensuite.extension.CallArdenSuiteServer</code>
MLM: Week of gestation	<code>medexter.ardensuite.extension.CallArdenSuiteServer</code>
Extracting week from MLM result	<code>medexter.activiti.hepatitis.ambulance.DecodeWeekOfGestation</code>
Getting PDF	<code>medexter.activiti.hepatitis.ambulance.AttachVirology</code>
Getting PDF	<code>medexter.activiti.hepatitis.ambulance.AttachRequirements</code>
MLM: Recommendation if breastfeeding is possible	<code>medexter.ardensuite.extension.CallArdenSuiteServer</code>
Extracting recommendation from MLM result	<code>medexter.activiti.hepatitis.ambulance.DecodeBreastfeedRecommendation</code>

Connecting Activity to the ARDENSUITE

In this *how-to*, we guide you step-by-step in the creation and configuration of Activiti BPMN service tasks that use Arden Syntax MLMs deployed on an ARDENSUITE Server. The ARDENSUITE Extension for Activiti is a library capable of performing REST or SOAP-based MLM calls to the ARDENSUITE Server.

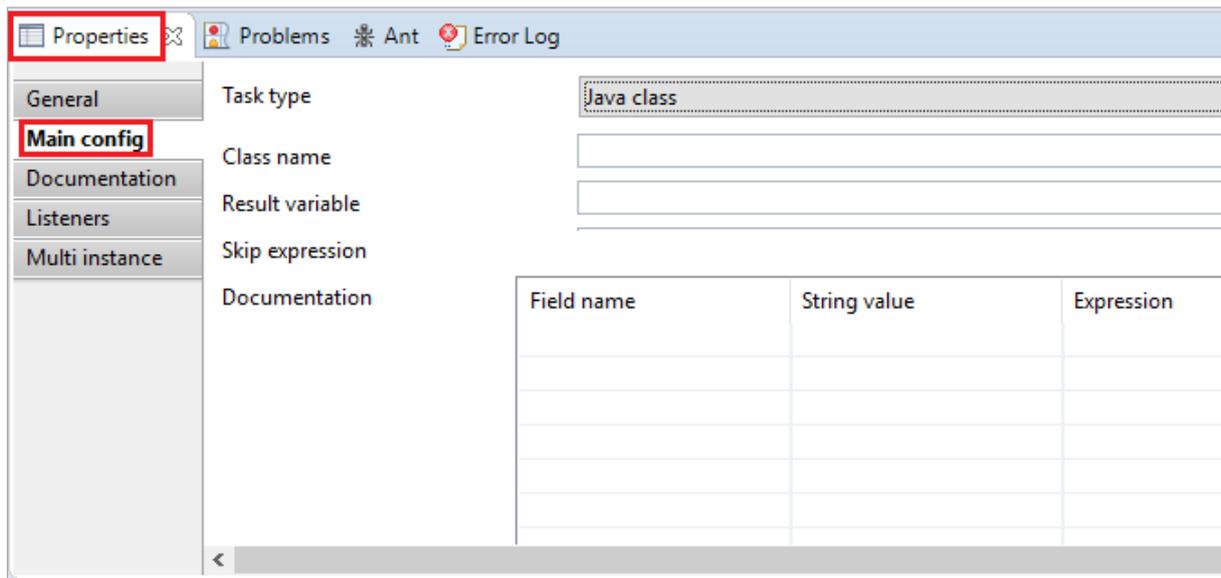
Creating an ARDENSUITE BPMN Service Task

Before showing how to implement the complete clinical guideline, we first would like to illustrate how an ARDENSUITE BPMN service task is created. First, you need to start Eclipse with the Activiti Designer plugin installed and select the [Activiti Explorer View](#). To select this view, press [Window](#) → [Show View](#) → [Other](#) (see figure below).



In the following [Show View](#) dialog, select [Activiti Explorer](#) from the [Activiti](#) folder. As a result, an Activiti Explorer workspace tab appears at the top left of the screen. In this workspace tab, create an [Activiti Project](#), and in this project an [Activity Diagram](#) (follow [these](#) instructions if you are not familiar with this process).

Now that you have created a diagram, a blank canvas appears in the main screen, together with a [Palette](#) menu with visual process creation options. In this [Palette](#) menu, select the [ServiceTask](#) in the [Task](#) submenu, and drag it to the canvas. Now, select the task, and in the [Properties](#) tab below, select the [Main config](#) menu (see figure below).



To connect the Activiti service task to the ARDENSUITE Server, enter (at least) the following information:

- **Task type:** The type has to be set as `Java class`.
- **Class name:** `medexter.ardensuite.extension.CallArdenSuiteServer`

Furthermore, the `Documentation` table can be used to inject variables directly into the class. To communicate with a specific MLM deployed on the ARDENSUITE Server, the following data need to be set:

Field name	String value
ASE_mlmname	The name of the corresponding MLM
ASE_mlminstitution	The institution of the corresponding MLM
ASE_mlmversion (optional)	The version of the corresponding MLM
ASE_outformat	Either JSON or XML
ASE_ActivitiVariable	The process variable used to store the ARDENSUITE Server response

Finally, click `Save` to store the parameters in the corresponding XML file.

Note: In some cases, the Activiti Designer does not save the process after inserting a java class that is not visible in the Eclipse workspace. Since you are using a jar file as a library, you may have to set the corresponding class manually in the process's XML file. To do so, right click on your Activiti process (with

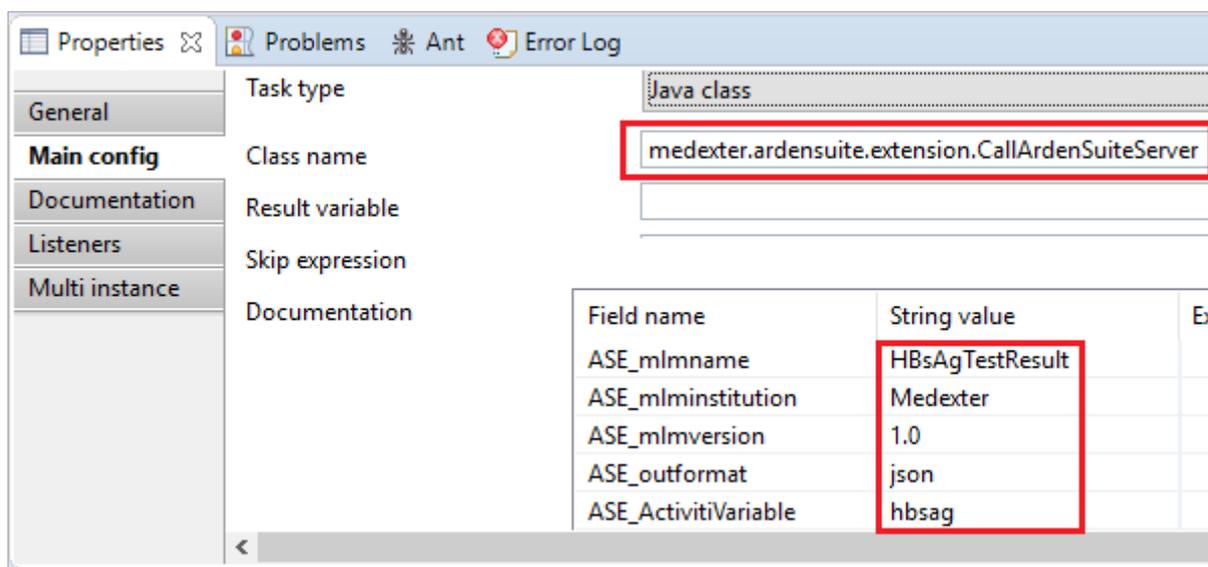
the extension .bpmn) and open it with an XML editor. Now you see your process as XML file. Go to your service task definition and append the following line as an attribute in the XML `ServiceTask` tag:

```
activiti:class="medexter.ardensuite.extension.CallArdenSuiteServer".
```

Click `Save`. The class should now be visible in the canvas.

Configuring a Workflow Containing ARDENSUITE BPMN Service Tasks

Now that you know the basics on how to create an ARDENSUITE BPMN service task, the next step is to analyze the clinical use case example. First, load the workflow by dragging the BPMN workflow process (`HepatitisBInPregnancy.bpmn`) into an Activiti project in Eclipse, and double-click it to show it on the canvas. You can see various service tasks in this workflow; the ones that call an MLM on the ARDENSUITE Server are marked with the prefix `MLM`. To make the workflow function for your Activiti account, you need to change the `Assignee` field in the `Main config` tab to your own Activiti user name for each `user task` in the workflow (only user tasks have an `Assignee` field in the main config tab. User tasks have different icons (a user icon) in the top left corner than service tasks (a cog icon)). Notice that when you click on the `MLM: HBsAg test result` task, you see that the service task calls the MLM `HBsAgTestResult` with all configured `Documentation` parameters mentioned above (see figure below).



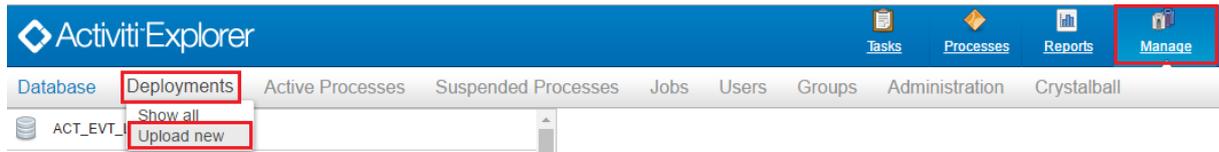
Field name	String value	Ex
ASE_mlmname	HBsAgTestResult	
ASE_mlminstitution	Medexter	
ASE_mlmversion	1.0	
ASE_outformat	json	
ASE_ActivitiVariable	hbsag	

Deploying and Running the Clinical Use Case Example

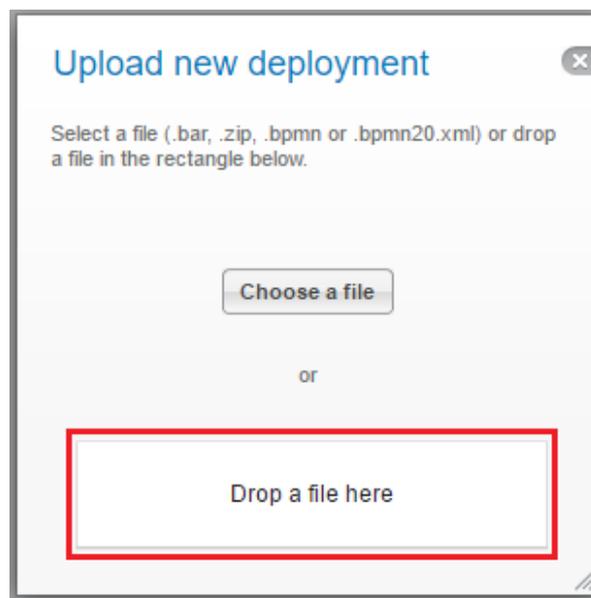
In order to deploy the clinical use case example, first login to Activiti. If we assume that Activiti is installed locally on port 8282, open a web-browser and go to:

<http://localhost:8282/activiti-explorer/>

After logging in, go to [Manage](#) → [Deployments](#), and click on [Upload new](#) (see figure below).

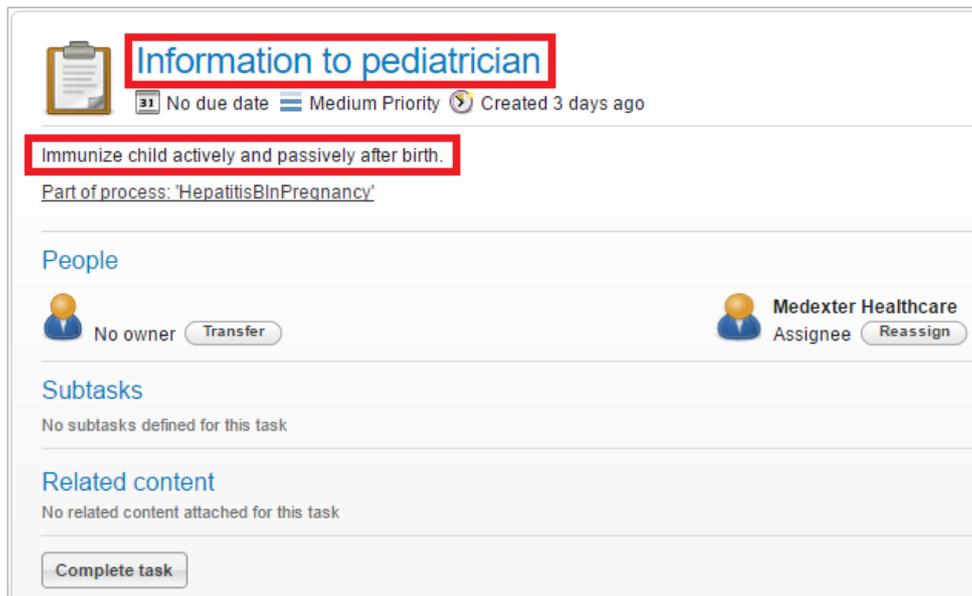


In the resulting dialog [Upload new deployment](#), drag and drop your process ([HepatitisBInPregnancy.bpmn](#)) into the [Drop a file here](#) area (see figure below).



Upon successful deployment, you can view the workflow by following [Processes](#) → [HepatitisBInPregnancy](#).

Now that the workflow is deployed and selected, you can start it by pressing the [Start process](#) button at the top right of the screen. This will take you to a window where you can perform the first task of the workflow, [Get ID](#). As an example, fill in the number [1](#) to simulate the workflow for [patient 1](#) in the database. For this patient, the [MLM: HBsAg test result](#) task yields positive, and workflow progresses into the [positive](#) path. This leads to the next task, [Information to pediatrician](#), thereby providing a pediatrician a reminder to “immunize child actively and passively after birth” (see figure below).



Information to pediatrician
 No due date Medium Priority Created 3 days ago

Immunize child actively and passively after birth.
 Part of process: 'HepatitisBlnPregnancy'

People

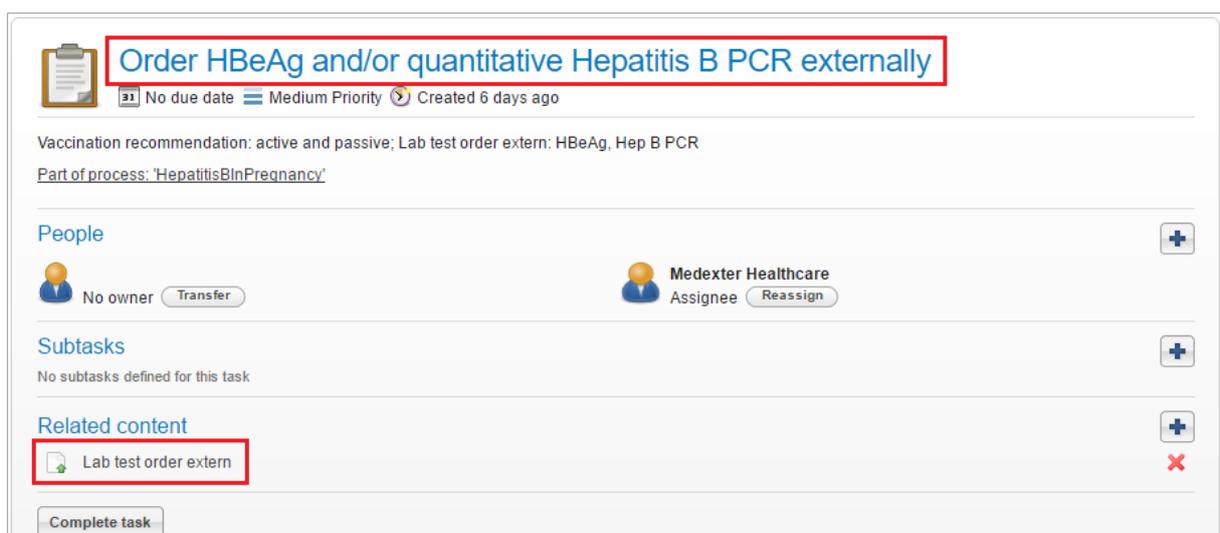
No owner [Transfer](#) Medexter Healthcare Assignee [Reassign](#)

Subtasks
 No subtasks defined for this task

Related content
 No related content attached for this task

[Complete task](#)

After this task is completed (by pressing the `Complete task` button on the bottom of the screen), the workflow executes another ARDENSUITE BPMN service task, `MLM: HBeAg and/or quantitative Hepatitis B PCR test result`, which verifies if results for HBeAg and PCR tests are available. Since they are not available for this patient, the workflow executes the third ARDENSUITE BPMN service task, `MLM: Week of gestation`. This MLM determines that the patient is not yet beyond the 38th week of gestation, thus returns a dialog for ordering external testing of HBeAg or PCR, including a link to an order form to be filled out by the physician (see figure below).



Order HBeAg and/or quantitative Hepatitis B PCR externally
 No due date Medium Priority Created 6 days ago

Vaccination recommendation: active and passive; Lab test order extern: HBeAg, Hep B PCR
 Part of process: 'HepatitisBlnPregnancy'

People

No owner [Transfer](#) Medexter Healthcare Assignee [Reassign](#)

Subtasks
 No subtasks defined for this task

Related content

Lab test order extern

[Complete task](#)

Finally, select `Complete task` and the workflow processing will come to an end.

Let us now consider `patient 2` in the database. Again, we start the workflow with the `Get ID` task. For this patient, the HBsAg test is also positive, thus the `MLM: HBsAg test result` task again yields positive, which leads to the `Information to pediatrician` task. Next, the

workflow moves on to the [MLM: HBeAg and/or quantitative Hepatitis B PCR test result](#) task, which in this case finds a positive HBeAg test result. Therefore, the [MLM: Recommendation if breastfeeding is possible](#) task is executed, which presents the result to you (see figure below)



Breastfeed Recommendation

 No due date  Medium Priority  Created 3 days ago

Breastfeeding after immunization possible
Part of process: 'HepatitisBInPregnancy'

People

 No owner [Transfer](#)  **Medexter Healthcare**
Assignee [Reassign](#)

Subtasks

No subtasks defined for this task

Related content

No related content attached for this task

[Complete task](#)