



Medexter Healthcare

# HOW TO COMPILE, TEST, AND DEPLOY MLMS WITH THE ARDENSUITE

SIRS Notification as an Example

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## Summary

The aim of this *how-to* instruction manual is to show how to compile and test Arden Syntax Medical Logic Modules (MLMs) in the [ARDENSUITE](#) IDE and—subsequently—how to deploy them on an ARDENSUITE Server.

## Document Information

### Target Audience

This instruction manual was created for ARDENSUITE users and developers interested in developing MLMs and deploying them on an ARDENSUITE Server.

## Impressum

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## Introduction

In this *how-to* instruction manual, we will guide you step-by-step in loading, compilation, testing and deployment of Arden Syntax Medical Logic Modules (MLMs). Throughout this *how-to*, we provide MLM use case examples containing notification rules for the systemic inflammatory response syndrome (SIRS). Clinically, the rules for SIRS notifications are as follows:

### **SIRS Notification**

ALERT if  $\geq 2$  Criteria

Temperature  $> 38^{\circ}\text{C}$  ( $100.4^{\circ}\text{F}$ ) or  $< 36^{\circ}\text{C}$  ( $96.8^{\circ}\text{F}$ )

and/or

Heart rate  $> 90$  beats per minute

and/or

Respiratory rate  $> 20$  breaths per minute or arterial carbon dioxide tension ( $\text{PaCO}_2$ )  $< 32$  mm Hg

and/or

White blood cell count ( $>12,000/\mu\text{L}$  or  $< 4,000/\mu\text{L}$  or  $>10\%$  immature [band] forms)

Following these provisions, MLMs were constructed that implement these notification rules and generate alerts when patient data match these criteria.

## 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 (for deployment and remote invocation)
- A REST client (for testing deployed MLMs)

## The ARDENSUITE IDE and ARDENSUITE Server

In case you do not have access to the ARDENSUITE IDE or the ARDENSUITE Server yet, please contact us at [support@medexter.com](mailto:support@medexter.com). A 30-day trial version of the ARDENSUITE can also be [downloaded here](#).

## REST Client

For instructional and testing purposes, REST calls to MLMs and their return values are illustrated using a web browser. In this document, we recommend using [Postman](#) for all REST communication.

## Files

This *how-to* is accompanied by two MLM files (extension `.mlm`):

- **CTD\_SIRS-Notification1**: This MLM evaluates the four SIRS notification criteria and returns an alert if two or more criteria are met. To illustrate error handling by the ARDENSUITE IDE, we inserted several errors in the Arden Syntax code.
- **CTD\_SIRS-Notification2**: This MLM is a corrected version of **CTD\_SIRS-Notification1**. This MLM contains no errors and can be tested and deployed.

and two text files with the input data for **CTD\_SIRS-Notification2** in JSON format:

(`rsc_REST1.txt` and `rsc_REST2.txt` )

**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.*

## MLM Input

For the MLMs used in this *how-to*, data is provided with each REST call. However, this is not the only way to provide external data for processing inside MLMs. Using the ARDENSUITE Server, there are altogether three different ways for an MLM to receive data from the outside:

### Input Data via REST

As described in the *how-to* document at hand.

### Database Connector via Curly Braces

Described in the following *how-to* document available in our online [Learning Center](#): *“Achieving Database Connectivity in Arden Syntax Using the ARDENSUITE Database Connector—SIRS Notification as an Example”*

### FHIR Connector via Curly Braces

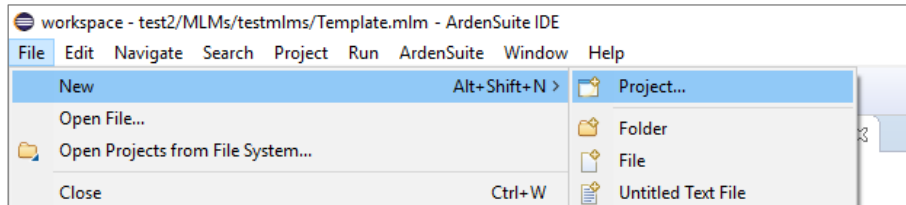
Described in the following *how-to* document available in our online [Learning Center](#): *“Achieving FHIR Connectivity in Arden Syntax Using the ARDENSUITE FHIR Connector”*

## Compiling an MLM in the ARDENSUITE IDE

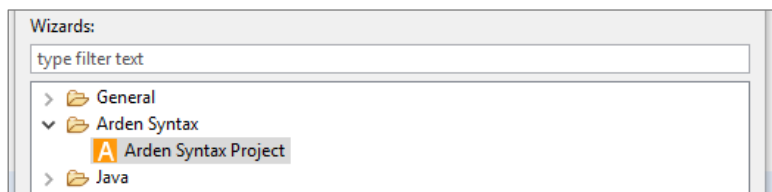
Start your ARDENSUITE IDE and choose your preferred workspace location. A workspace is a folder on your system, where projects and custom IDE settings are stored. For example if you want to show line

numbers: **Window -> Preferences -> General -> Editors -> Text Editors -> Check 'Show line numbers'**, this setting will be stored in and for your workspace.

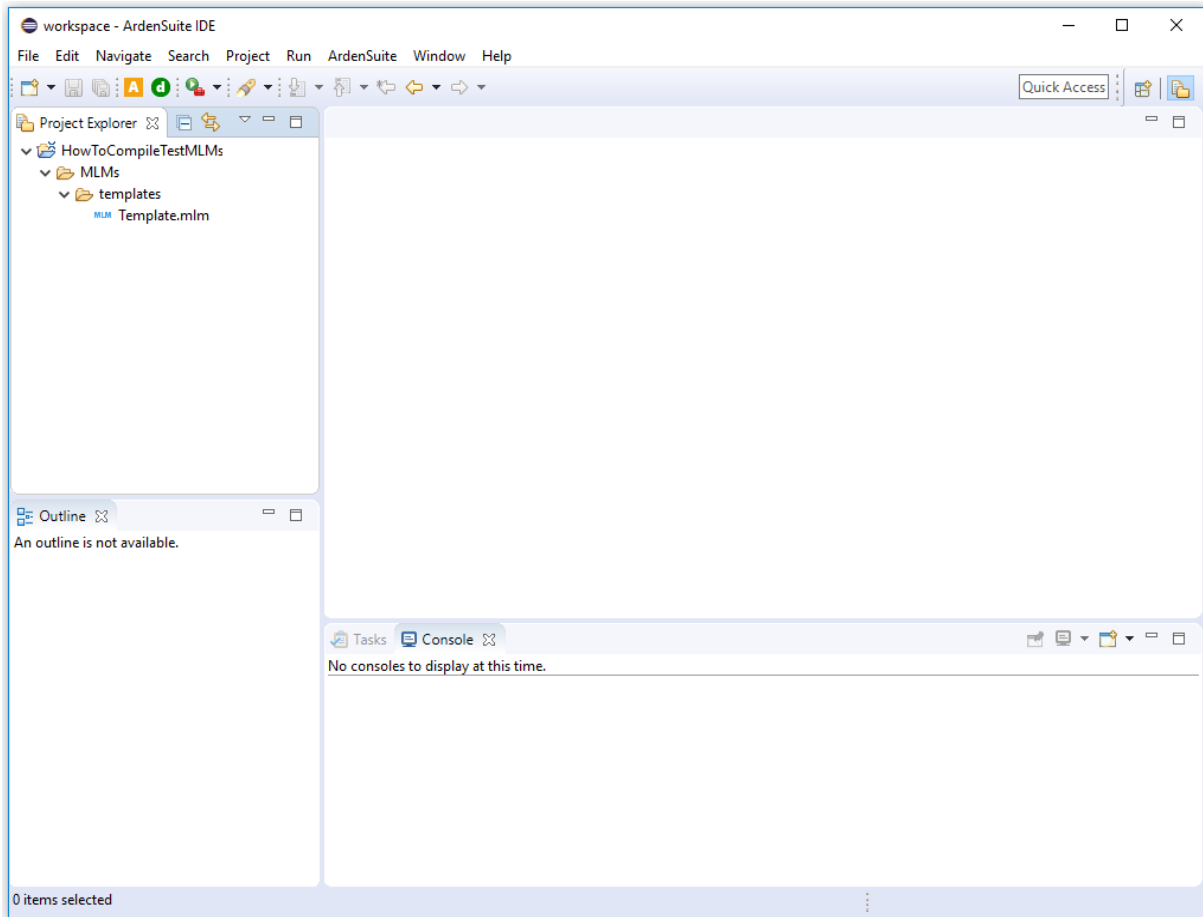
Before you can create or load MLMs, you have to create an Arden Syntax Project. Do this by clicking **File -> New -> Project** in the Menu (see figure below).



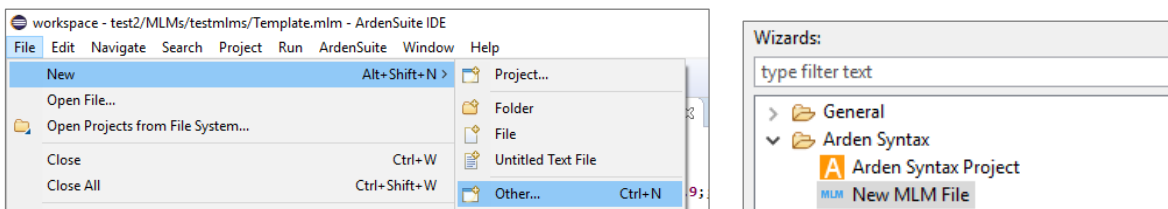
Select **Arden Syntax Project** from the category **Arden Syntax**. Choose a project name. Click **Finish** to create the project. The wizard will automatically generate a template **.mlm** file. This template MLM is simply able to accept two input parameters and return a string as result.



At default settings, the newly created Arden Syntax Project will appear in the Project Explorer on the left side of the IDE. It includes two folders named **MLMs** and **templates**. You may delete these folders and create new ones with custom names at any time.



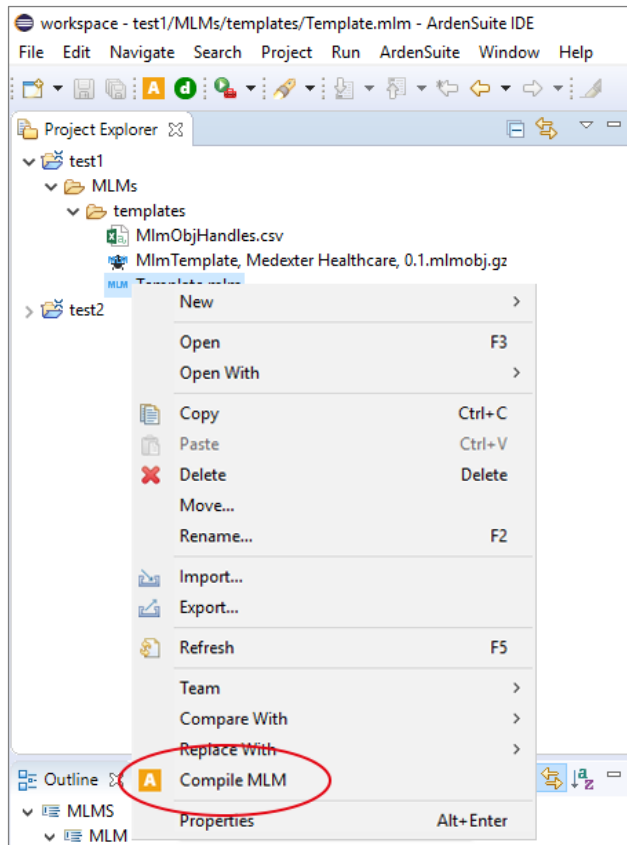
Generate a new MLM file by clicking **File -> New -> Other** to open another wizard. Select **New MLM File** from the category **Arden Syntax**. This wizard allows you to choose a file name (e.g., **CTD\_SIRS-Notification1.mlm**) and the location where this file should be generated (**Browse** button). Choose a folder from your newly created project.



Copy the content of our provided **CTD\_SIRS-Notification1.mlm** to your newly created file and do the same with **CTD\_SIRS-Notification2.mlm**. You can also drag-and-drop those files onto one of the project's folders (choose **copy files**) or just copy them to the project location on your hard disk (right-click on your project and click **Refresh** for newly added files to show up).

There are several ways to **compile an MLM**:

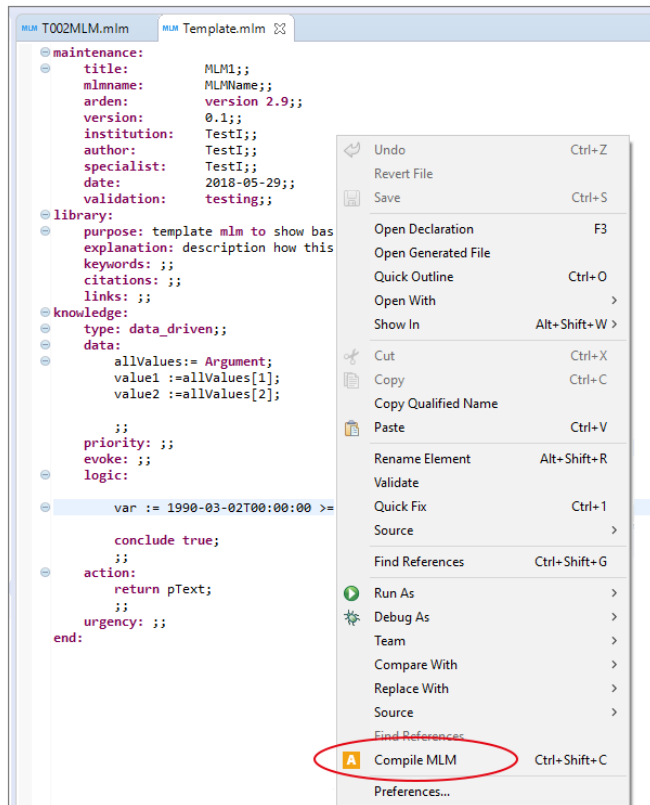
- Right-click on the MLM in the tree structure on the left pane, and click on the menu item **Compile MLM**



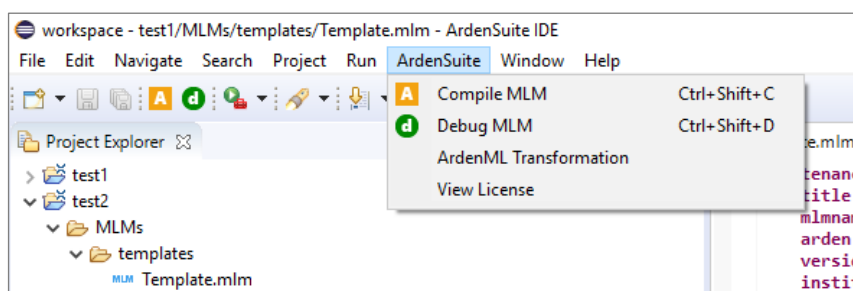


- Right-click on the code in the main screen on the right, and click on the menu item

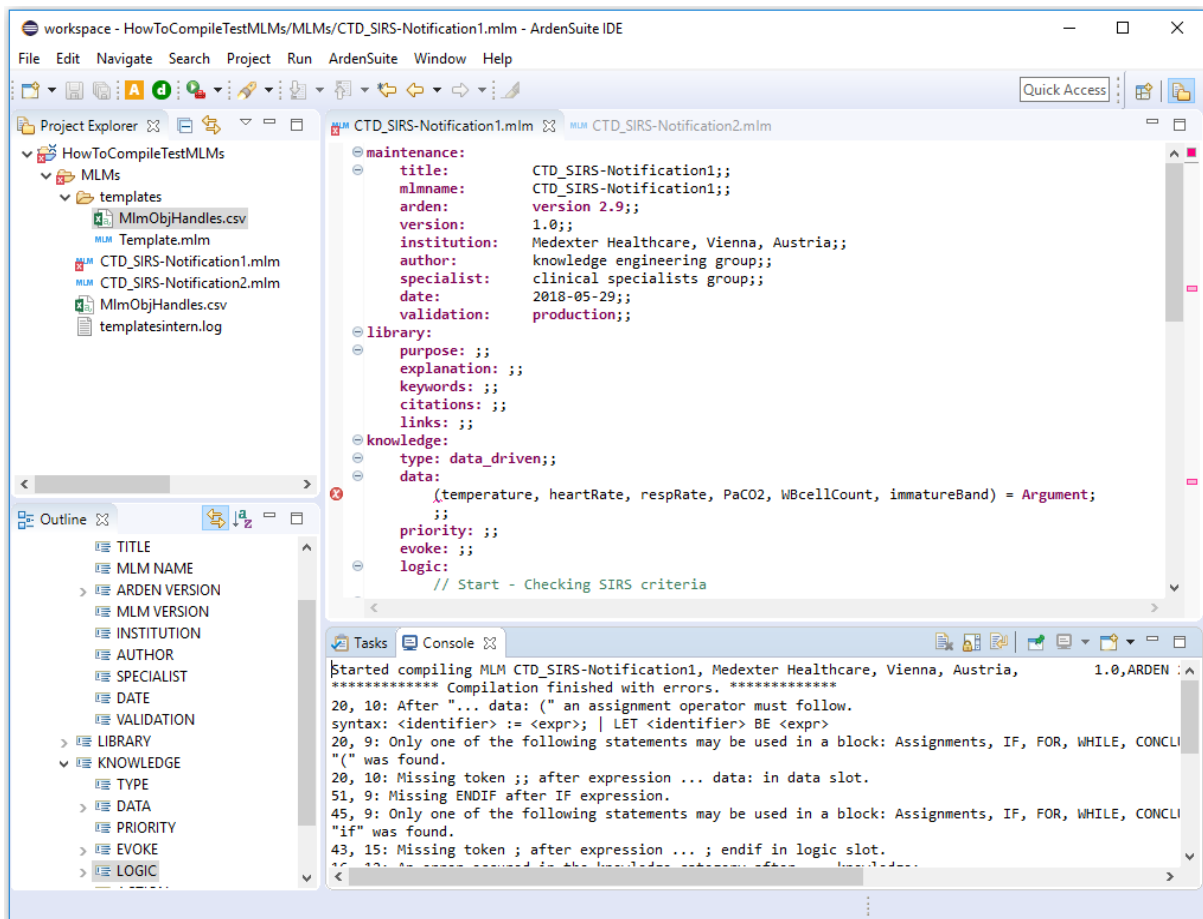
### Compile MLM



- Use the main menu: **ArdenSuite** -> **Compile MLM** (this will compile the MLM currently displayed in the editor)



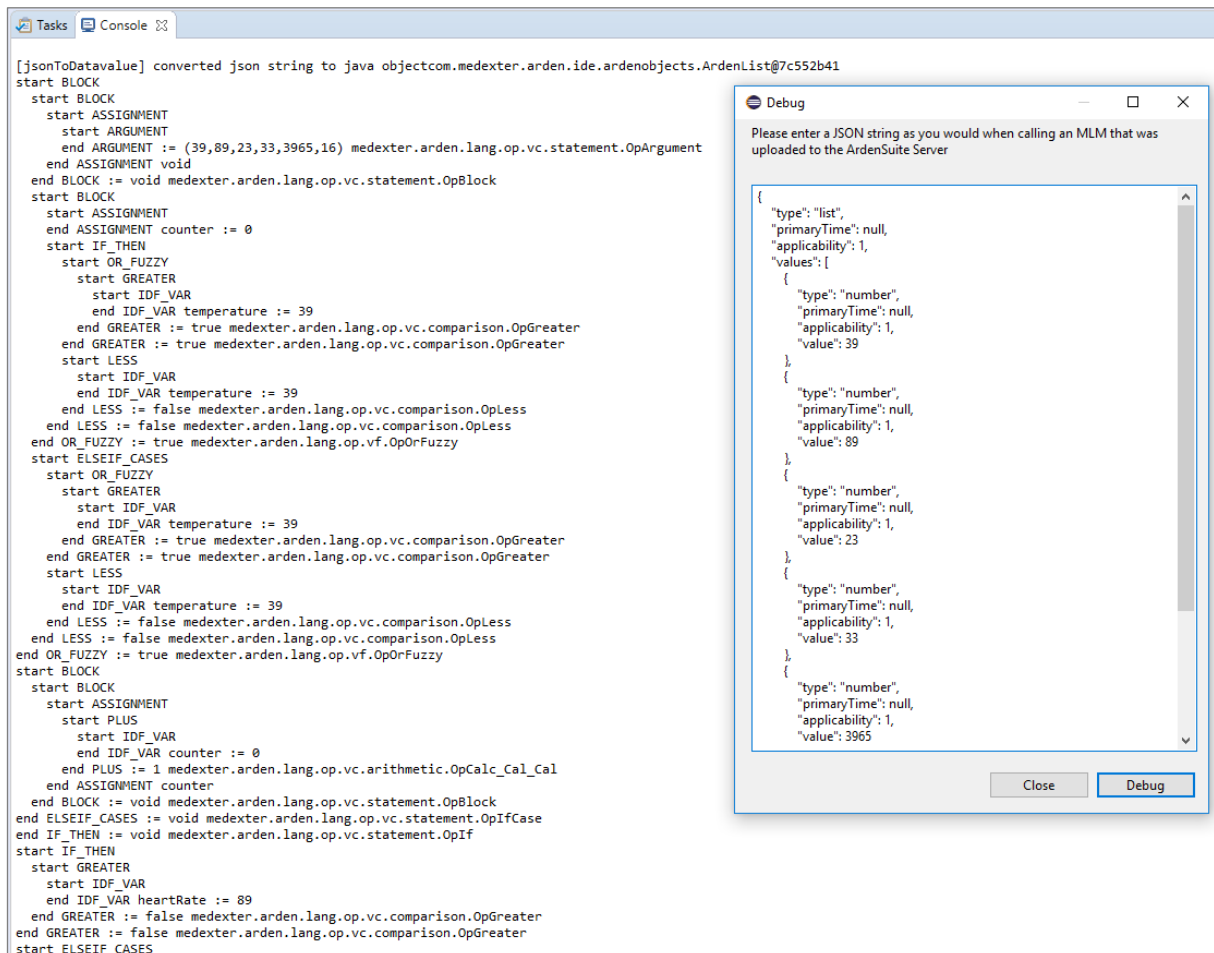
When compiling an MLM, compilation feedback will appear at the bottom pane of the screen. While compiling **CTD\_SIRS-Notification1**, you will notice that several error messages appear (see figure below).



Additionally, the editor’s syntax highlighting may give a hint where to search for an error. The MLM **CTD\_SIRS-Notification1** contains two program errors. The assignment in line 20 is missing a **:** character and the **if** statement in line 45 is missing an **endif;** statement. Upon compiling a correct MLM, i.e., **CTD\_SIRS-Notification2**, compilation feedback will show no errors. Furthermore, two extra entries appear in the tree structure on the left pane: a metadata file (**MlmObjHandles.csv**) and a compiled MLM (**.mlmobj.gz**) which may be uploaded to the ARDENSUITE Server or used for testing/debugging purposes.

## Testing an MLM in the ARDENSUITE IDE

To test a compiled MLM, you need to right-click on a compiled MLM (**.mlmobj.gz**) in the Project Explorer to open a context menu and choose **Debug MLM**. This will open an input window, where input parameters can be specified in JSON format, the same format you will use when calling an MLM on the ARDENSUITE Server via REST.



The MLM `CTD_SIRS-Notification2` expects a flat list with 6 values as input, as shown in the following code snippet:

`(temperature, heartRate, respRate, PaCO2, WBcellCount, immatureBand) = Argument`

Please enter the following list of parameters to test/debug the `CTD_SIRS-Notification2` MLM:

```
{
  "type": "list",
  "primaryTime": null,
  "applicability": 1,
  "values": [
    {
      "type": "number",
      "primaryTime": null,
      "applicability": 1,
      "value": 39
    },
    {
      "type": "number",
      "primaryTime": null,
      "applicability": 1,
      "value": 89
    },
    {
      "type": "number",
      "primaryTime": null,
      "applicability": 1,
      "value": 23
    },
    {
      "type": "number",
      "primaryTime": null,
      "applicability": 1,
      "value": 33
    },
    {
      "type": "number",
      "primaryTime": null,
      "applicability": 1,
      "value": 3965
    },
    {
      "type": "number",
      "primaryTime": null,
      "applicability": 1,
      "value": 16
    }
  ]
}
```

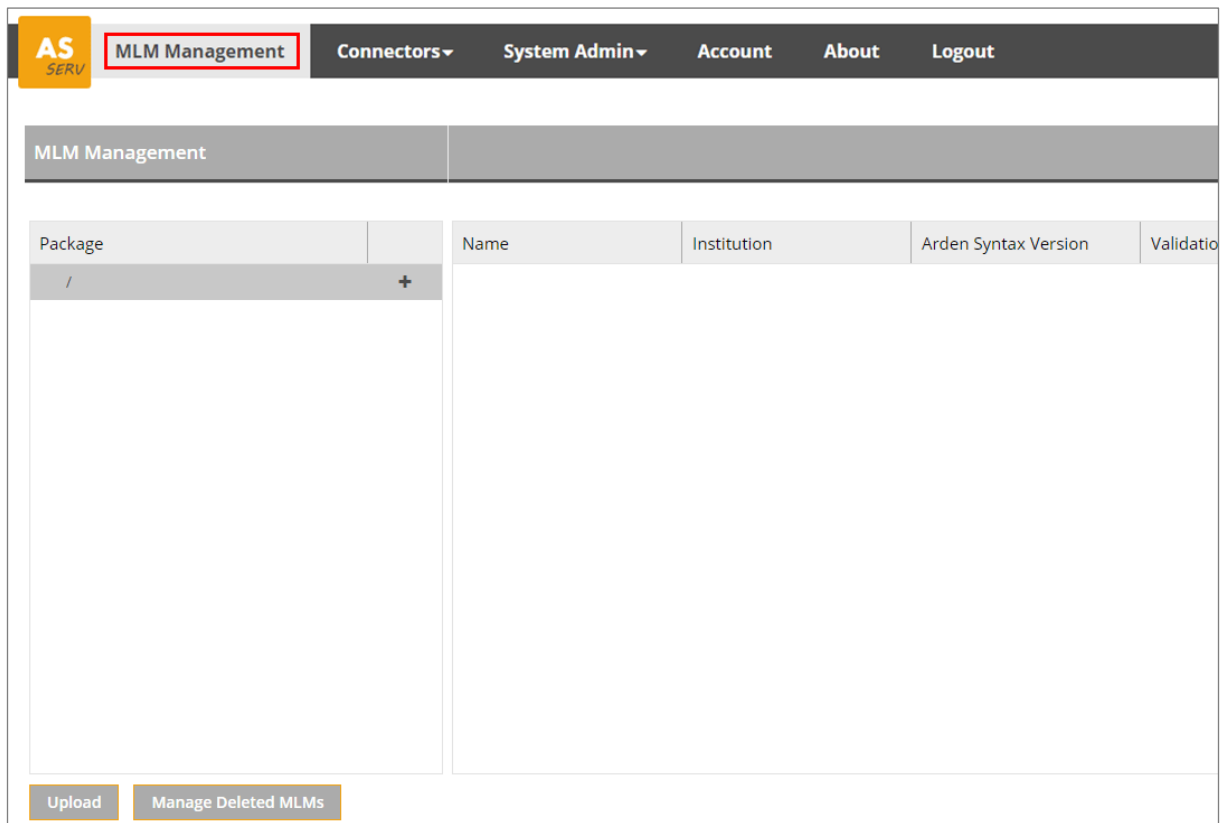
```
    "value": 89
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 23
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 33
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 3965
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 16
  }
]
}
```

**Note:** This JSON input can also be found in the `rsc_REST1.txt` in the `.zip`-folder accompanying this how-to document.

Based on these inputs, the expected output would be a string containing an alert for SIRS. In the console, you can see that all internal operations while executing the MLM are printed to the console in the same order as they are processed by the Arden Syntax Engine. This output might help to track down logic flaws or runtime errors.

## Deploying Compiled MLMs on the ARDENSUITE Server

In order to call MLMs remotely, they need to be deployed on the ARDENSUITE Server. To deploy MLMs, login to the ARDENSUITE Server and select **MLM Management** in the top menu (see figure below).



To upload a compiled MLM to the root directory, simply select **/** in the left pane under **Package** and press **Upload**. Alternatively, you can create a separate package for your MLMs by pressing **+**. Please provide a name, description, institution, and version for the package (see figure below).

### Add Package ✕

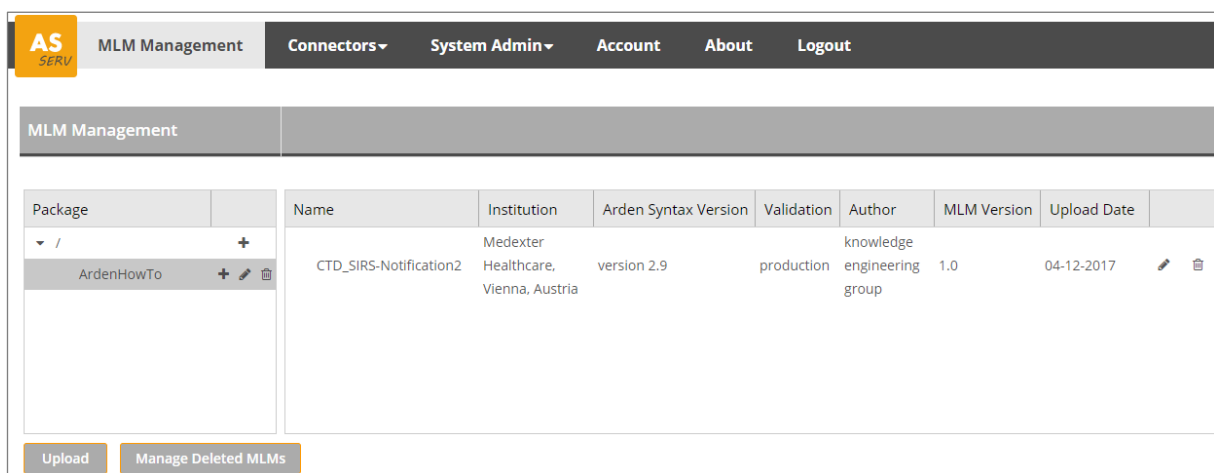
Name	<input type="text" value="ArdenHowTo"/>
Description	<input type="text" value="Arden How-to SIRS MLMs"/>
Institution	<input type="text" value="Medexter Healthcare"/>
Version	<input type="text" value="1"/>
Parent	<input type="text" value="/"/>

To add the package to the ARDENSUITE Server, press the **OK** button. A package will appear on the left pane of the screen. To upload MLMs to this package instead of uploading them to the root directory,

select the package (e.g., **ArdenHowTo**) and press the **Upload** button. You are then asked to select the compiled MLM you want to upload (file extension **.mlmobj.gz**); here, only one MLM can be uploaded at a time.

**Note:** *It is possible to upload several MLMs at once. First, pack all the compiled MLMs you want to upload in a .zip container. Then upload the .zip file to the ARDENSUITE Server. The server will then automatically unpack the container and deploy the MLMs.*

After deployment of the compiled MLM **CTD\_SIRS-Notification2** in the package **ArdenHowTo**, the screen looks as follows:



To call this MLM, start Postman and construct the REST call. For more information on how to call MLMs using REST, we refer to the corresponding *how-to* document, which can be found [here](#). After starting Postman, use the following URL for the MLM REST call (POST):

**http://localhost:8080/REST/CALLMLM?mlmName=CTD\_SIRS-Notification2&mlmInstitution=Medexter Healthcare, Vienna, Austria**

Do not forget to add a basic authorization header to your REST call (Postman – Authorization tab). In case of our test scenario, the JSON data that needs to be supplied in the **Body** segment of the REST call is the same as before, used to test/debug the MLM with the IDE:

**Note:** *Again, this JSON input can also be found in the **rsc\_REST1.txt** file in the .zip-folder accompanying this how-to document.*

```
{
  "type": "list",
  "primaryTime": null,
  "applicability": 1,
  "values": [
    {
      "type": "number",
      "primaryTime": null,

```

```
    "applicability": 1,
    "value": 39
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 89
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 23
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 33
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 3965
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 16
  }
]
}
```

If everything worked out as it should and no errors occurred, the server returns an alert for SIRS. The alert looks like this:

```
{
  "type": "string",
  "primaryTime": null,
  "applicability": 1,
  "value": "Alert for SIRS"
}
```

The following input will not trigger an alert for SIRS. The result is null, since the MLM does not return anything in that case.

**Note:** This JSON input can also be found in the `rsc_REST2.txt` file in the `.zip`-folder accompanying this how-to document.

```
{
```

```

"type": "list",
"primaryTime": null,
"applicability": 1,
"values": [
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 37
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 89
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 19
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 30
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 5000
  },
  {
    "type": "number",
    "primaryTime": null,
    "applicability": 1,
    "value": 9
  }
]
}

```

## Further User Support and Documentation

This *how-to* instruction manual is part of our online [Learning Center](#). Further available *how-to* documents are:

- Achieving **Database** Connectivity in Arden Syntax Using the ARDENSUITE Database Connector—  
*SIRS Notification as an Example*
- How to Call Arden Syntax MLMs on an ARDENSUITE Server Using **REST and SOAP**—



*SIRS Notification as an Example*

- Achieving **FHIR** Connectivity in Arden Syntax Using the ARDENSUITE FHIR Connector
- Achieving System Connectivity between **Activiti** BPMN Platform and the ARDENSUITE—

*Hepatitis B in Pregnancy as an Example*

Visit the **ARDENSUITE Support Pages** online for a detailed documentation:

[https://www.medexter.com/ardensuite\\_support](https://www.medexter.com/ardensuite_support)

Or contact us with any questions at [support@medexter.com](mailto:support@medexter.com).