

# NEMESIS V3 Custom Element Guide

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## Overview

This guide describes how to implement custom elements in NEMESIS version 3. Custom elements are sometimes necessary to transmit information in a NEMESIS XML document that cannot be handled using existing NEMESIS data elements. The NEMESIS 3 XML Schema (XSD) provides a standardized structure for defining custom elements and producing custom element result data. Examples of custom element implementations that are supported by the NEMESIS standard include the following:

- Adding a data element
- Extending an existing NEMESIS element with additional choices or detail
- Creating a correlated group of custom data elements

This guide provides some sample scenarios where custom elements would be needed and demonstrates how they would be implemented.

## Custom Element Structures in the NEMESIS XML Schema

Both of the core NEMESIS XML schemas—DEMDDataSet (agency demographic data) and EMSDataSet (patient care report data)—provide a facility for defining custom elements and producing custom element results in a NEMESIS XML document. The structural pattern is the same in both schemas. (The only difference between the two schemas is that element names in DEMDataSet begin with “d,” while element names in EMSDataSet begin with “e.”)

The NEMESIS XML schema handles custom elements in two sections:

1. (d|e)CustomConfiguration, in the header of a document, is the structure that is used to provide custom element definitions.

2. (d|e)CustomResults, within each record (EMS agency or PCR) in a document, is the structure that is used to provide custom element result data.

With this structure, custom elements are defined globally for a NEMSIS XML document, and custom element result data are recorded within each record (EMS agency or PCR) in the document. A system receiving and processing NEMSIS XML data can use the custom element definitions in (d|e)CustomConfiguration to understand the custom element result data in (d|e)CustomResults.

See the [NEMSIS Data Dictionary](#) for full documentation of the (d|e)CustomConfiguration and (d|e)CustomResults structures.

## Creating a Stand-alone Custom Element

This scenario describes the implementation of a custom data element on a PCR that has no relationship to any existing NEMESIS data elements. A data dictionary page for the element would look like this:

cePatient.01 - Recent Travel Outside U.S.			
Definition			
Has the patient traveled outside the United States in the last 30 days?			
National Element		Pertinent Negatives (PN)	No
State Element	Yes	Not Values (NV)	No
Version 2 Element		Is Nillable	Yes
Usage	Optional	Recurrence	0 : 1
Code List			

Code	NEMESIS Code	Description
1		No
2		Yes

The element may be rendered in a data entry interface like this:

Recent Travel Outside U.S.

No
Yes

The custom element definition and result would be implemented in a NEMESIS XML document as illustrated on the following page:

```

<EMSDataset ...>
  <Header>
    <DemographicGroup>
      ...
    </DemographicGroup>
    <eCustomConfiguration>
      <eCustomConfiguration.CustomGroup CustomElementID="cePatient.01">
        <eCustomConfiguration.01>Recent Travel Outside U.S.</eCustomConfiguration.01>
        <eCustomConfiguration.02>
          Has the patient traveled outside the United States in the last 30 days?
        </eCustomConfiguration.02>
        <eCustomConfiguration.03>9902009</eCustomConfiguration.03>
        <eCustomConfiguration.04>9923001</eCustomConfiguration.04>
        <eCustomConfiguration.05>9903007</eCustomConfiguration.05>
        <eCustomConfiguration.06 customValueDescription="No">1</eCustomConfiguration.06>
        <eCustomConfiguration.06 customValueDescription="Yes">2</eCustomConfiguration.06>
      </eCustomConfiguration.CustomGroup>
    </eCustomConfiguration>
    <PatientCareReport>
      ...
      <eCustomResults>
        <eCustomResults.ResultsGroup>
          <eCustomResults.01>2</eCustomResults.01>
          <eCustomResults.02>cePatient.01</eCustomResults.02>
        </eCustomResults.ResultsGroup>
      </eCustomResults>
      ...
    </PatientCareReport>
  </Header>
</EMSDataset>

```

In this example, the data in eCustomConfiguration define the custom data element. The data in eCustomResults contain two data elements. The value of eCustomResults.01 is the custom element result (in this case, 2, which means “Yes”). The value of eCustomResults.02 references the CustomElementID attribute of the custom element definition so that the software receiving the data knows that this custom element result is for the “Recent Travel Outside U.S.” custom data element.

The element is defined as optional. If the user selected neither of the choices on the code list, then the data in eCustomResults would be omitted from the PCR in the XML document.

## Extending an Existing NEMESIS Element

This scenario describes the implementation of a custom data element on a PCR that adds choices to the list of an existing NEMESIS data element. The data dictionary page for eMedications.08 Medication Complication might be extended to look like this:

eMedications.08 - Medication Complication			
Definition			
Any complication (abnormal effect on the patient) associated with the administration of the medication to the patient by EMS			
National Element	Yes	Pertinent Negatives (PN)	No
State Element	Yes	Not Values (NV)	Yes
Version 2 Element	E18_08	Is Nillable	Yes
Usage	Required	Recurrence	1 : M
Attributes			

### Not Values (NV)

7701001 - Not Applicable      7701003 - Not Recorded

### CorrelationID

**Data Type:** String      **minLength:** 0      **maxLength:** 255

### Code List

Code	NEMESIS Code	Description
	3708001	Altered Mental Status
	3708003	Apnea
	3708005	Bleeding
	3708007	Bradycardia
	3708009	Bradypnea
<b>c101</b>	<b>3708035</b>	<b>Breathing Rate Change</b>
	3708011	Diarrhea
	3708013	Extravasation
<b>c102</b>	<b>3708035</b>	<b>Grunting</b>
	3708015	Hypertension
	3708017	Hyperthermia
	3708019	Hypotension
	3708021	Hypothermia
	3708023	Hypoxia
	3708025	Injury
	3708043	Itching
	3708029	Nausea
	3708031	None
<b>c103</b>	<b>3708035</b>	<b>Nose Flaring</b>
	3708033	Other
	3708035	Respiratory Distress
	3708037	Tachycardia
	3708039	Tachypnea
	3708045	Urticaria
	3708041	Vomiting
<b>c104</b>	<b>3708035</b>	<b>Wheezing</b>

These are custom values. In this example, all of them are specific types of respiratory distress, so they all map to the NEMESIS code for "Respiratory Distress."

The element may be rendered in a data entry interface like this:

Medication Complication  
(Select all that apply)

These are custom values.

Altered Mental Status	▲
Apnea	
.....	
Nose Flaring	
Other	
Respiratory Distress	
Tachycardia	
Tachypnea	
Urticaria	
Vomiting	
Wheezing	▼

A diagram showing a data entry interface for 'Medication Complication (Select all that apply)'. The interface is a vertical list of options with a scroll bar on the right. The options are: Altered Mental Status (with an upward arrow), Apnea, a dashed line indicating a scroll, Nose Flaring, Other, Respiratory Distress, Tachycardia, Tachypnea, Urticaria, Vomiting, and Wheezing (with a downward arrow). A green bracket on the left side of the list encompasses the items from 'Nose Flaring' to 'Wheezing', with a callout box stating 'These are custom values.'

The custom element definition and result would be implemented in a NEMESIS XML document as illustrated on the following page:

```

<EMSDataset ...>
  <Header>
    <DemographicGroup>
      ...
    </DemographicGroup>
    <eCustomConfiguration>
      <eCustomConfiguration.CustomGroup CustomElementID="eMedications.08">
        <eCustomConfiguration.01 nemsisElement="eMedications.08">
          Medication Complication
        </eCustomConfiguration.01>
        <eCustomConfiguration.02>
          Any complication (abnormal effect on the patient) associated with the
          administration of the medication to the patient by EMS
        </eCustomConfiguration.02>
        <eCustomConfiguration.03>9902009</eCustomConfiguration.03>
        <eCustomConfiguration.04>9923003</eCustomConfiguration.04>
        <eCustomConfiguration.05>9903003</eCustomConfiguration.05>
        <eCustomConfiguration.06 nemsisCode="3708035"
          customValueDescription="Breathing Rate Change">c101</eCustomConfiguration.06>
        <eCustomConfiguration.06 nemsisCode="3708035"
          customValueDescription="Grunting">c102</eCustomConfiguration.06>
        <eCustomConfiguration.06 nemsisCode="3708035"
          customValueDescription="Nose Flaring">c103</eCustomConfiguration.06>
        <eCustomConfiguration.06 nemsisCode="3708035"
          customValueDescription="Wheezing">c104</eCustomConfiguration.06>
        <eCustomConfiguration.07>7701001</eCustomConfiguration.07>
        <eCustomConfiguration.07>7701003</eCustomConfiguration.07>
      </eCustomConfiguration.CustomGroup>
    </eCustomConfiguration>
    <PatientCareReport>
      ...
      <eMedications>
        <eMedications.MedicationGroup>
          ...
          <eMedications.08 CorrelationID="1001">3708029</eMedications.08>
          <eMedications.08 CorrelationID="1002">3708035</eMedications.08>
          <eMedications.08 CorrelationID="1003">3708035</eMedications.08>
          ...
        </eMedications.MedicationGroup>
      </eMedications>
      ...
      <eCustomResults>
        <eCustomResults.ResultsGroup>
          <eCustomResults.01>c102</eCustomResults.01>
          <eCustomResults.02>eMedications.08</eCustomResults.02>
          <eCustomResults.03>1002</eCustomResults.03>
        </eCustomResults.ResultsGroup>
        <eCustomResults.ResultsGroup>
          <eCustomResults.01>c104</eCustomResults.01>
          <eCustomResults.02>eMedications.08</eCustomResults.02>
          <eCustomResults.03>1003</eCustomResults.03>
        </eCustomResults.ResultsGroup>
      </eCustomResults>
      ...
    </PatientCareReport>
  </Header>
</EMSDataset>

```

In this example, eCustomResults.03 has been added to each custom element result group. Because multiple medications may be administered on a PCR, and each medication administration may have multiple complications, it is necessary to use eCustomResults.03 to indicate which medication complication instance is being extended. The value of eCustomResults.03 is the content of the CorrelationID attribute on the data element that is being extended. The purpose of the CorrelationID attribute in the NEMESIS standard is to allow custom element data to be correlated with an existing data element instance, as demonstrated here.

The two instances of eMedications.08 that are being extended contain the NEMESIS code for “Respiratory Distress” (3708035), because the custom element configuration states that “Grunting” and “Wheezing” both map to the standard NEMESIS code for “Respiratory Distress.” This is important, because when a NEMESIS XML document is sent to the national EMS database, it includes only the national data elements. All custom element definitions and results are removed from the document. The national EMS database only receives `<eMedications.08>3708035</eMedications.08>`.

Since this custom data element has been defined to have a recurrence of 1:M, and since both of the custom element results in this example map to the same standard NEMESIS code, it would also be acceptable to generate only one instance of eMedications.08 with the standard NEMESIS code and only one custom element result group with multiple values for eCustomResults.01, like this:

```
<eMedications>
  <eMedications.MedicationGroup>
    ...
    <eMedications.08 CorrelationID="1001">3708029</eMedications.08>
    <eMedications.08 CorrelationID="1002">3708035</eMedications.08>
    ...
  </eMedications.MedicationGroup>
</eMedications>
...
<eCustomResults>
  <eCustomResults.ResultsGroup>
    <eCustomResults.01>c102</eCustomResults.01>
    <eCustomResults.01>c104</eCustomResults.01>
    <eCustomResults.02>eMedications.08</eCustomResults.02>
    <eCustomResults.03>1002</eCustomResults.03>
  </eCustomResults.ResultsGroup>
</eCustomResults>
```



## Creating a Group of Custom Elements

This scenario describes the implementation of a correlated group of custom data elements on a PCR. Several data elements are included in the group, and the group may occur multiple times in a PCR. A data dictionary structure for the group would look like this:

1 : M	Patient Restraints		
1 : 1	ceRestraint.01 - Date/Time Patient Restraint Occurred	R	N, L
1 : 1	ceRestraint.02 - Type of Patient Restraint	R	N, L
1 : 1	ceRestraint.03 - Reason for Patient Restraint	R	N, L

The data dictionary pages for the individual custom elements would look like this:

ceRestraint.01 - Date/Time Patient Restraint Occurred			
Definition			
The date and time the patient was restrained.			
National Element		Pertinent Negatives (PN)	No
State Element	Yes	Not Values (NV)	No
Version 2 Element		Is Nillable	Yes
Usage	Required	Recurrence	1 : M
Constraints			

### Data Type

Date/Time

ceRestraint.02 - Type of Patient Restraint			
Definition			
The type of restraint used on the patient.			
National Element		Pertinent Negatives (PN)	No
State Element	Yes	Not Values (NV)	Yes
Version 2 Element		Is Nillable	Yes
Usage	Required	Recurrence	1 : 1
Grouping ID			

ceRestraint.01

### Attributes

#### Not Values (NV)

7701001 - Not Applicable

7701003 - Not Recorded

### Constraints

### Data Type

Text/String

### ceRestraint.03 - Reason for Patient Restraint

#### Definition

The reason for restraining the patient.

National Element		Pertinent Negatives (PN)	No
State Element	Yes	Not Values (NV)	Yes
Version 2 Element		Is Nillable	Yes
Usage	Required	Recurrence	1 : 1

#### Grouping ID

ceRestraint.01

#### Attributes

##### Not Values (NV)

7701001 - Not Applicable

7701003 - Not Recorded

#### Constraints

##### Data Type

Text/String

The elements may be rendered in the data entry interface like this:

#### Patient Restraints

Date/Time Patient Restraint Occurred	Type of Patient Restraint	Reason for Patient Restraint
01/30/2018 13:01:00	Stretcher restraint	To place pt in ambulance
01/30/2018 13:20:00	Straight jacket	Pt became combative
<input type="button" value="+ Add Another"/>		

The NEMSIS custom element structure does not support a way to define a group header like “Patient Restraints” and then tie multiple elements to that header. Instead, one element must be defined as the “parent” or “key” element, and the other elements can be tied to that element.

The custom element definitions and results would be implemented in a NEMSIS XML document like this:

```

<EMSDataset ...>
  <Header>
    <DemographicGroup>
      ...
    </DemographicGroup>
    <eCustomConfiguration>
      <eCustomConfiguration.CustomGroup CustomElementID="ceRestraint.01">
        <eCustomConfiguration.01>
          Date/Time Patient Restraint Occurred
        </eCustomConfiguration.01>
        <eCustomConfiguration.02>
          The date and time the patient was restrained.
        </eCustomConfiguration.02>
        <eCustomConfiguration.03>9902003</eCustomConfiguration.03>
        <eCustomConfiguration.04>9923003</eCustomConfiguration.04>
        <eCustomConfiguration.05>9903001</eCustomConfiguration.05>
      </eCustomConfiguration.CustomGroup>
      <eCustomConfiguration.CustomGroup CustomElementID="ceRestraint.02">
        <eCustomConfiguration.01>
          Type of Patient Restraint
        </eCustomConfiguration.01>
        <eCustomConfiguration.02>
          The type of restraint used on the patient.
        </eCustomConfiguration.02>
        <eCustomConfiguration.03>9902009</eCustomConfiguration.03>
        <eCustomConfiguration.04>9923001</eCustomConfiguration.04>
        <eCustomConfiguration.05>9903003</eCustomConfiguration.05>
        <eCustomConfiguration.07>7701001</eCustomConfiguration.07>
        <eCustomConfiguration.07>7701003</eCustomConfiguration.07>
        <eCustomConfiguration.09>ceRestraint.01</eCustomConfiguration.09>
      </eCustomConfiguration.CustomGroup>
      <eCustomConfiguration.CustomGroup CustomElementID="ceRestraint.03">
        <eCustomConfiguration.01>
          Reason for Patient Restraint
        </eCustomConfiguration.01>
        <eCustomConfiguration.02>
          The reason for restraining the patient.
        </eCustomConfiguration.02>
        <eCustomConfiguration.03>9902009</eCustomConfiguration.03>
        <eCustomConfiguration.04>9923001</eCustomConfiguration.04>
        <eCustomConfiguration.05>9903003</eCustomConfiguration.05>
        <eCustomConfiguration.07>7701001</eCustomConfiguration.07>
        <eCustomConfiguration.07>7701003</eCustomConfiguration.07>
        <eCustomConfiguration.09>ceRestraint.01</eCustomConfiguration.09>
      </eCustomConfiguration.CustomGroup>
    </eCustomConfiguration>
  </Header>
</EMSDataset>

```

Continued on next page...

```

<PatientCareReport>
  ...
  <eCustomResults>
    <eCustomResults.ResultsGroup CorrelationID="1004">
      <eCustomResults.01>2018-01-30T13:01:00-05:00</eCustomResults.01>
      <eCustomResults.02>ceRestraint.01</eCustomResults.02>
    </eCustomResults.ResultsGroup>
    <eCustomResults.ResultsGroup>
      <eCustomResults.01>Stretcher restraint</eCustomResults.01>
      <eCustomResults.02>ceRestraint.02</eCustomResults.02>
      <eCustomResults.03>1004</eCustomResults.03>
    </eCustomResults.ResultsGroup>
    <eCustomResults.ResultsGroup>
      <eCustomResults.01>To place pt in ambulance</eCustomResults.01>
      <eCustomResults.02>ceRestraint.03</eCustomResults.02>
      <eCustomResults.03>1004</eCustomResults.03>
    </eCustomResults.ResultsGroup>

    <eCustomResults.ResultsGroup CorrelationID="1005">
      <eCustomResults.01>2018-01-30T13:20:00-05:00</eCustomResults.01>
      <eCustomResults.02>ceRestraint.01</eCustomResults.02>
    </eCustomResults.ResultsGroup>
    <eCustomResults.ResultsGroup>
      <eCustomResults.01>Straight jacket</eCustomResults.01>
      <eCustomResults.02>ceRestraint.02</eCustomResults.02>
      <eCustomResults.03>1005</eCustomResults.03>
    </eCustomResults.ResultsGroup>
    <eCustomResults.ResultsGroup>
      <eCustomResults.01>Pt became combative</eCustomResults.01>
      <eCustomResults.02>ceRestraint.03</eCustomResults.02>
      <eCustomResults.03>1005</eCustomResults.03>
    </eCustomResults.ResultsGroup>

  </eCustomResults>
  ...
</PatientCareReport>
</Header>
</EMSDataSet>

```

In this example, eCustomConfiguration.09 has been added to the custom element configuration for “Type of Patient Restraint” and “Reason for Patient Restraint.” Because those two data elements must be correlated to a specific “Date/Time Patient Restraint Occurred,” it is necessary to use eCustomConfiguration.09 to define the correlation. The value of eCustomConfiguration.09 is the content of the CorrelationID attribute on the custom element configuration for “Date/Time Patient Restraint Occurred.”

Also, eCustomResults.03 has been added to the custom element result groups for “Type of Patient Restraint” and “Reason for Patient Restraint.” The value of eCustomResults.03 is the content of the CorrelationID attribute on a specific custom data element result group for “Date/Time Patient Restraint Occurred,” so that the software receiving the data knows that the stretcher restraint to place the patient in the ambulance was applied at 13:01, while the straight jacket because the patient became combative was applied at 13:20.

## Validating Custom Element Data

(d|e)CustomConfiguration is used to document the definition of a custom data element, including its constraints, such as data type, recurrence, potential values, Not Values, and Pertinent Negatives. However, since those constraints are defined within the XML document itself, not within the XSD, they are not enforced during XML Schema (XSD) validation. For example, the NEMSIS XSD defines the data type for eCustomResults.01 as a string with a maximum length of 100,000, and it allows any Not Value or Pertinent Negative attribute. Thus, even though the eCustomConfiguration section within a NEMSIS XML document may define the custom data element for “Recent Travel Outside U.S.” as a coded list with “1” and “2” as the allowed values, XSD validation will only check to verify that it is a string of no more than 100,000 characters.

Custom element validation can be implemented using a Schematron schema. For example, a state may do the following to standardize and validate custom data elements:

- Publish a StateDataSet document that provides the configuration for custom data elements that the state wishes to receive from EMS agencies.
- Publish a Schematron schema containing rules that validate custom element results per the state configuration.

## Optimizing XML Containing Custom Elements

The custom element structure adds overhead to NEMSIS XML documents, via custom element configuration information and the presence of CorrelationID attributes. Following are some implementation notes regarding approaches to minimize the overhead of custom elements:

- If a NEMSIS XML document contains no custom element result data, then custom element configuration data and CorrelationID attributes may be omitted from the document. (One exception is that an eProcedures.ProcedureGroup must have a CorrelationID attribute if there are any instances of eAirway.ConfirmationGroup that reference it.) CorrelationID attributes only need to be present on elements that are referenced by custom element results (or airway confirmations).
- If a system has a large number of custom elements, but a NEMSIS XML document contains custom element result data for only some custom elements, then the document need only include the custom element configuration information for those elements.
- If a custom element configuration contains a large list of potential values, but only some of those values are used in a NEMSIS XML document, then it may be acceptable for (d|e)CustomConfiguration.06 to only include the values that are used in the document.
- Custom element configuration information is generally included in every XML document that contains custom element result data, because the sending system usually must assume that the receiving system has no prior knowledge of the custom element configuration information. If the managers of the sending and receiving systems have agreed on the custom element configurations in advance (for example, a local system sending data to a state system, where the

state has published the custom element configurations via a StateDataSet), then it may be acceptable to omit the custom element configuration information from a NEMSIS XML document. In this case, the value of (d|e)CustomResults.02 in the custom element result data would act as a key for the receiving system to reference its own custom element configuration information.

Some receiving systems may have validation rules in place that disallow some of these optimization approaches.

## Conclusions

The NEMSIS version 3 XML Schema provides a way to support the transmission of custom data within standard NEMSIS XML documents. The implementation of custom elements usually requires development effort on the part of software vendors in order to validate and store the custom data, and to provide a reasonable user interface for the collection of the custom data. Efforts should be made to fit existing NEMSIS data elements to state and EMS agency needs, without repurposing or redefining the standard elements. When no existing NEMSIS data element fits the need, the custom element structure can be used to implement custom elements in standardized way that minimizes development cost and variability between products.