

## Linking Epic To NEWT ([www.newbornweight.org](http://www.newbornweight.org))

The publicly available and free to use website, [www.newbornweight.org](http://www.newbornweight.org), which houses the Newborn Weight Tool (NEWT), can now be linked to Epic. NEWT is the first tool created that allows pediatric healthcare providers and parents to see how a newborn's weight during the first days following childbirth compares with a large sample of newborns. Using a research sample of birth weights from more than 100,000 breastfed newborns, the tool uses a nomogram to plot a baby's weight percentile at any given time in the first few days following birth compared with the research population. The results can be used for early identification of neonates on a trajectory for greater weight loss and related complications.

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## SMART on FHIR Approach

UCSF implemented NEWT using SMART on FHIR, which we plan to release to the community soon. If you are interested in reusing our implementation, please reach out to me at [andrew.robinson@ucsf.edu](mailto:andrew.robinson@ucsf.edu).

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## Web Integration Approach

### Required Data Mapping

The NEWT contextual launch requires several discrete elements to be passed as parameters in the launch URL. **You must map these data points to values in your Epic system.** We have included mapping *suggestions* below, which you must validate for use in your unique Epic instance.

1. Birth Instant (I HSB 35420, I EPT 110/111)
  2. Birth Weight (I HSB 35401, I EPT 19401, R FLO 14, LOINC 3141-9, etc.)
  3. Subsequent Weights, with accompanying instants (R FLO 14, LOINC 3141-9, etc.)
  4. Delivery Method, Vaginal or C-Section (I HSB 35413, I EPT 19413)
  5. Feeding method, breastmilk or formula (FLO)
    - Please note the following limitation - Because the graphs generated by the research supporting NEWT involved those exclusively breastfeeding or exclusively formula feeding, note that if a newborn is fed BOTH breastmilk and formula, their data will chart them as if they were exclusively breastfeeding. This can be manually changed as needed once the chart is produced for an individual.
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## Create your Generic Rules (CER)

We will create several Patient Scoring rules in order to provide NEWT with required data. These rules will be used later in this guide.

## Birth Time

We convert the delivery summary birth instant in UTC to seconds since unix epoch using the result output. Another option is to pull birth date/time from `I EPT 110/111` and use the `Create Instant` property.

### Context: Registry Metrics

General Properties » OB Delivery Record: Newborn » OB Delivery: Birth Instant

NEWT Birth Instant (Seconds Since Unix Epoch) 2010517  Allow Override?

Returns the birth instant in seconds since the unix epoch.

Return type:

Evaluation logic:

#	Property	Operator	Value	Result Type	Result
1	General Properties » OB Delivery Record: Newborn » OB Delivery: Birth Instant Local or UTC <input type="text" value="UTC [2]"/>	<=>		Property Column Value	----

## Birth Weight

There are many ways to obtain birth weight (HSB, EPT, FLO, LOINC). In this example, we are using the birth weight as documented in the delivery summary.

### Context: Registry Metrics

General Properties » OB Delivery Record: Newborn » OB Delivery: Infant Birth Weight

NEWT Birth Weight (KG) 2010518  Allow Override?

Returns the birth weight in KG.

Return type:

Evaluation logic:

**Show Parameter Values**

#	Property	Operator	Value	Result Type	Result
1	General Properties » OB Delivery Record: Newborn » OB Delivery: Infant Birth Weight	<=>		Property Column Value	----

Format: METRIC (ENGLISH)

Round to Whole Unit?

## Delivery Method

Using the delivery method, as documented in HSB, we map all of our C-Section methods to return  and *default* to  if the method is anything else.

### Context: Registry Metrics

General Properties » OB Delivery Record: Newborn » OB Delivery: Delivery Method

General Properties » String

NEWT Delivery Method (VAG or CES) 2010519  Allow Override?

Returns the delivery method as vag=Vaginal or ces=Cesarean

Return type:

Evaluation logic:

**Show Parameter Values**

#	Property	Operator	Value	Result Type	Result
1	General Properties » OB Delivery Record: Newborn » OB Delivery: Delivery Method	=	Low transverse C/S [14] Low vertical C/S [15] Classical C/S [16] Cesarean hysterectomy [17] C-Section, Low Transverse [251] C-Section, Unspecified [253] C-Section, Low Vertical [259] C-Section, Classical [260]	Property	General Properties » String <input type="text" value="ces"/>
2	General Properties » String	<=>		Property Column Value	----

String:

## Feeding Method

Feeding method (breastmilk or formula) documentation will vary across organizations. In

this example, we use a custom flowsheet row and search for the value “Exclusive Formula Fed Infant”. Note that your organization *will* use a different mechanism to document feeding type, such as a Flowsheet mapped to [LOINC 67704-7](#). Additionally, NEWT doesn’t evaluate feeding type after a max of 4 days, but we show the feeding method based charts until a weight is entered that forces use of the “one-month” chart (i.e. weight entered at >96 hours of life for a breastfed vaginal delivery).

### Context: Registry Metrics

General Properties » Flowsheets: Patient Has Value Equal To

General Properties » String

NEWT Feeding Method (BF or FF) 2010521  Allow Override?

Returns the feeding method as bf=Breastfed, ff=Formula Fed (defaults to breastfed if not EXCLUSIVELY formula fed)

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Return type:

Evaluation logic:

**Show Parameter Values**

#	Property	Operator	Value	Result Type	Result
1	<a href="#">General Properties »</a> <a href="#">Flowsheets: Patient Has Value Equal To</a> Flowsheet Row(s) <input checked="" type="checkbox"/> R I CN DIET TYPE_1... Flowsheet Value(s) <input checked="" type="checkbox"/> Exclusive Formula... Lookback Days <input type="text" value="4"/> Start Date	<=>		Property	<a href="#">General Properties »</a> <b>String</b> String <input type="text" value="ff"/>
2	<a href="#">General Properties »</a> <a href="#">String</a> String <input type="text" value="bf"/>	<=>		Property Column Value	----

### Chart Type (optional)

NEWT has one set of nomograms for the first 3-4 days, and another set for the first 30 days. In order to show the correct chart, we evaluate the patient’s hour of life at their last weight measurement. If the patient age in hours at last weight was >96 hours we show the “one month” chart. If you omit this parameter, the user can manually select the chart type after NEWT is launched.

### Context: Patient Score Rules

Patient » Flowsheet: Value

Patient » OB Delivery Record: Newborn » OB Delivery: Birth Instant

NEWT Age in Hours at Last Weight Documented 37000071

Return patient age in hours at their last weight measurement

Evaluation logic: Sum of true lines First true line (s1-s2)/60\60

**Show Parameter Values**

#	Property	Operator	Value	Result Type	Result
1	<a href="#">Patient</a> » <a href="#">Flowsheet: Value</a> Flowsheet Row WEIGHT/SCALE [14] Return Type Last Instant [2] Encounters to Search Current Encounter... Lookback Start Arrival [1] Lookback Start Modifier Lookback End Now [3] Lookback End Modifier Episode Type Data Extensions	<>		Property Column Value	----
2	<a href="#">Patient</a> » <a href="#">OB Delivery Record: Newborn</a> » <a href="#">OB Delivery: Birth Instant</a> Local or UTC Local [1]	<>		Property Column Value	----

### Context: Registry Metrics

General Properties » Evaluate Rule

General Properties » String

NEWT Chart Type 2010526  Allow Override?

Returns "one\_month" if patient had a weight measurement at >96 hours of age

NOTE: This is not precise as different 3-4 day charts have different max age!

Return type:

Evaluation logic:

**Show Parameter Values**

#	Property	Operator	Value	Result Type	Result
1	General Properties > <input type="button" value="🔍"/> <input type="button" value="🔧 Evaluate Rule"/>	>	96	Property	General Properties > <input type="button" value="🔍"/> <b>String</b>
	Rule				String
	<input type="text" value="NEWT Age in Hours..."/>				<input type="text" value="one_month"/>
	Data Source				
	Data Type and Combine Logic				
	External Metric ID				

## Install custom code

In order to safely generate and format the subsequent weight string, custom code is required. Work with your Epic TS to install the following code.

```
XNEWT ;

q
;*****
; PURPOSE: Newborn Weight Tool (NEWT) Helper
; AUTHOR: Andrew Robinson - andrew.robinson@ucsf.edu
;*****
;
;-----
; SCOPE: PUBLIC
; DESCRIPTION: Generate URL string for subsequent weights parameter
; PARAMETERS:
; patID (I,REQ) - Patient ID
; patDAT (I,REQ) - Patient Encounter DAT
; RETURNS: URL formatted reoccurring parameter string
;-----
subsequentWeights(patID,patDAT) q:(patID='')!(patDAT='') ""
n glo,index,i,result,timestamp,weight
s glo=$zGtTmpGlo()
;
```

```

; Get all patient weights (R FLO 14)
d RetrieveFLOData^JRWBCEC1(14,patID,patDAT,"","",glo,"","",1)
;
; Loop through weights and format
s index=$o(@glo@("DATA",14,"")) ;don't include the patient's first (birth)
weight
f s index=$o(@glo@("DATA",14,index)) q:index="" d s i=$i(i)
. ;
. ; Get instant and weight from flowsheet value
. s timestamp=$zLocal2UTC(index)-4070908800 ;convert instant
to seconds since unix epoch
. s weight=$zConvWeight(@glo@("DATA",14,index),"oz","kg",2) ;convert oz to
kg
. ;
. ; Add parameters to URL string
. s result=$zStrAddPiece(result,"&",$param(i,"timestamp",timestamp))
. s result=$zStrAddPiece(result,"&",$param(i,"weight",weight))
;
d %zRelTmpGlo(glo)
q $$urlSafeStr(result) ;return URL encoded result
;
;;#localInline#
;-----
; SCOPE: PRIVATE
; DESCRIPTION: Weight parameter formatting
; PARAMETERS:
; i (I,REQ) - Index number
; param (I,REQ) - Parameter string
; value (I,REQ) - Parameter value
; RETURNS: i[param]=value (ex: 1[weight]=3.14)
;-----
param(i,param,value) q +i_"["_param_"]=_value ;;#endLocalInline#
q ;;#eor#

```

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## Create your Extensions (LPP)

Integration Token Extensions are required to pull data into the NEWT URL. These

extensions will be referenced during Integration Configuration in tokens formatted as

`%EXTENSION;<LPP>%`.

## Evaluate Rule

For each of the following parameters (birth time, birth weight, delivery method, feeding method, and optionally chart type) create an extension of type **Integration Token [52023]** with the following setup, replacing `<param>` and `<rule>` with the appropriate name and rule (CER) based on the rules you created above:

**Name:** NEWT `<param>` Integration Token

**Type:** Integration Token [52023]

**Code:** `$p($$evalRule^elibHULIB22(<rule>,eptID,eptDAT,"","","","","",""),$c(6))`

Example:

### Extension - NEWT Birth Weight Integration Token [100870]

[Audit Trail](#)

Name:

Type:

Code:

Comments:

## Subsequent Weights

An extension is required for generating the weight string.

**Name:** NEWT Subsequent Weights Integration Token

**Type:** Integration Token [52023]

**Code:** `$$subsequentWeights^XNEWT(eptID,eptDAT)`



**Extension - NEWT Subsequent Weights Integration Token [100875]**

Audit Trail

Name:

Type:

Code:

Comments:   
 URL decoded:  
 0[timestamp]=1564198200&0[weight]=2.35&1[timestamp]=1564313400&1[weight]=2.24&2[timestamp]=1564399800&2[weight]=2.22&3[timestamp]=1564480800&3[weight]=2.2  
 URL encoded:

## Create your Integration Configuration (FDI)

NEWT defines the following URL parameters, which we will populate with an Integration Configuration (FDI) record using the integration tokens we completed above:

- meas = Subsequent Weights
- bs = Birth Time
- bw = Birth Weight
- bt = Delivery Method
- fm = Feeding Method
- ct = Chart Type (optional: default is 3-4 day chart, one\_month results in the 30 day chart)

- Open the  Activity and create and name a new configuration (i.e. "NEWT Integration").

- Configure your new record with the following settings:

- **Type:**
- **Model Record:**

- Configure the Installation Mnemonic Values as follows, replacing [tokens] with your extension (LPP) IDs created earlier in this guide:

- **PATIENTOPENURL:**
- **LAUNCHTYPE:**  (this indicates NEWT should launch in the sidebar)

Example PATIENTOPENURL:

```
https://www.newbornweight.org/?meas=%EXTENSION;100100%&bs=%EXTENSION;
100101%&bw=%EXTENSION;100102%&bt=%EXTENSION;100103%&fm=%EXTENSION;
100104%&ct=%EXTENSION;100105%
```

Epic Reference: [Integrating External Web Applications into Epic Setup and Support Guide](#)

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## Create your Activity (E2N)

- Duplicate the Epic released activity `MR_CLINKB_ENCOUNTER_SELECT`
- Open your copy and configure as follows:
  - **Activity descriptor:** `NEWBORN_WEIGHT_TOOL`
  - **Menu type:** `Item`
  - **Caption:** `Newborn Weight Tool`
  - **Tooltip:** `Newborn Weight Tool (NEWT)`
  - **Style:** `128`
  - **Form Style:** `2105344`

| Work with your Epic TS for assistance or to configure your activity further

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## Create your Menu (E2U)

- Create and name a new Menu (E2U) record in Chronicles (i.e. "NEWBORN\_WEIGHT\_TOOL")
- Configure your menu as follows:
  - **Menu descriptor:** `NEWBORN_WEIGHT_TOOL`
  - **Menu type:** `Item`
  - **Available to Applications:** `DESKTOP`
  - **Caption:** `Newborn Weight Tool`
  - **Toolbar Tooltip:** `Newborn Weight Tool (NEWT)`
  - **Activity descriptor:** `<Your copy of MR_CLINKB_ENCOUNTER_SELECT>`
- Page down to the `Run Parameters` page:
  - **URL by FDI:** `<Your Integration Configuration from Above>`

```
andrewrobinson — ssh robinsoand@apexpoc.ucsfmedicalcenter.org — 80x24
[Menu Name: NEWBORN_WEIGHT_TOOL
-----
General Information
-----
Menu descriptor: NEWBORN_WEIGHT_TOOL
Menu type: Item
Description: Newborn Weight Tool Launch Menu

Available to Applications      Restricted to Hosts      MenuGroup
1. DESKTOP

-----
Override Information
-----
Overrides menu descriptor:

-----
Press <F13> for Extended Input
-----
Contact your system representative before modifying records in this database.
```

```
andrewrobinson — ssh robinsoand@apexpoc.ucsfmedicalcenter.org — 80x24
-----
Run Parameters
-----
Parameter      Value [F13]-Extend Entry
1. URL by FDI  _100041-NEWT INTEGRATION (NON-FHIR)
2. URL
3. Mappings for ordering
4. URL by extension
5. Activity mapping table
6. Flowsheet signature
7. Flowsheet template
8. Search context
9. Search parameter
10. Use anesthesia contac*

-----
Parameter Details
-----
Type: Record ID      List: No      INI: FDI
Can use F6 to edit/view parameter value.
-----
[F6] Edit/View Parameter Values
-----
```

- Add your menu to Hyperspace in an appropriate place in your clinicians' workflow (refer to the Build the Web Application into Your Chosen Workflow section of the Epic reference below)

| Work with your Epic TS for assistance or to configure your menu further

Epic Reference: [Integrating External Web Applications into Epic Setup and Support Guide](#)

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## Bells and Whistles

### Display NEWT Automatically

We have programmed the website to appear automatically if the baby has subsequent weight entered at >6 hours of life.

<TODO>

### Use NEWT Centiles in Clarity

<TODO>

### Use NEWT Centiles in Chronicles (Rules, BPAs, etc.)

<TODO>