

# Feeding FHIR with LHC-Forms

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# What is LHC-forms and what can it do?

## LHC-Forms is Powerful

<https://lhncbc.nlm.nih.gov/project/lforms>

- ❑ A fast, web based open source JavaScript program (300kB) generates live forms on-the-fly using JSON form descriptions.
- ❑ Accommodates nested groups and repeating groups of questions (e.g. Surgeon General's Family Health History).
- ❑ Has all of the usual form functions -- Skip logic, rich validation checks, auto complete menus, score calculation, other calculations
- ❑ Answer lists displayed as columnated grid with autocomplete functions.
- ❑ Many different layout styles and responsive design that fits any screen size.
- ❑ Some examples follow

## LHC-Forms are standards oriented

- ❑ All LOINC 2000+ LOINC panels *are* LHC forms.
  - ❑ Same for most of NLM's Common Data Elements (CDEs) – not all LOINC.
    - NIH Common Data Elements (CDE) Repository: <https://cde.nlm.nih.gov/home>
- ❑ Form questions modeled after to HL7 observations with data types, cardinality, units of measure for quantities and answer lists for ordinal variables.
- ❑ Has external (standard) vocabulary tables (e.g. RxNorm, LOINC, ICD, many genomic standards) with auto-complete service.
- ❑ LHC-Forms service (<https://lhncbc.nlm.nih.gov/project/lforms>) generates HL7 v2 messages from entered data.
- ❑ Via SMART, can link to patient resource (now), and deliver captured data to FHIR resource(s). (Stay tuned for today's demo.)

## Lots of rich form (questionnaire content) in LOINC

- ❑ Most CMS forms (OASIS, MDS, Dialysis) and CMS is organizing all of their assessment instruments around LOINC (e.g. CDC birth and death certificates).
- ❑ Lots of psychosocial surveys (e.g. PROMIS, Neuro-QOL), Clinical structures, ventilator variables, 12-lead EKG, Pulmonary function tests (Mayo), cardiac echos (DICOM) , Nursing instruments (ANA), Lab panels, Ophthalmology measures (NEI), etc.

## Associated Tools Services

- ❑ Form builder for creating new forms and editing old ones
- ❑ Docker for delivering packages.
- ❑ JSON Schema for LHC-Forms.
  - ❖ Form: <https://github.com/lhncbc/lforms-validator/blob/master/lforms-form-schema.json>
  - ❖ Item: <https://github.com/lhncbc/lforms-validator/blob/master/lforms-item-schema.json>
- ❑ Clinical table linker- provides machinery for questions whose answers come from external tables
  - ❖ “Secret sauce”: via URL, implementer can specify what fields are searched, which are returned as part of columnated grid, and which are stored in the value field as hidden variables  
<https://clin-table-search.lhc.nlm.nih.gov/>
  - ❖ Other fields in the form can use these hidden variables as answer lists, default values or help messages -- will demonstrate.

# LHC-Forms Demo Screenshots

- Matrix
- Nested and repeating groups
- Score computation
- Auto-complete
- Auto defaults

# "Matrix" Legend showing PROMIS Social isolation panel

PROMIS item bank - social isolation - version 2.0 ©					
Date Done	Time Done	Where Done	Comment		
MM/DD/YYYY	Type a value	Select or type a value ▼	Type a value		
	Never	Rarely	Sometimes	Usually	Always
People get the wrong idea about my situation ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel isolated even when I am not alone ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that people avoid talking to me ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel detached from other people ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that some of my friends avoid me ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that some of my family members avoid me ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that I am alone in my interests and ideas ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that people barely know me ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel like a stranger to those around me ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find that friends or relatives have difficulty talking with me about my health ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that people are around me but not with me ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel isolated from others ©	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>





# Nested and Repeating Groups

## Surgeon General's family health history as an LHC-Form

Date Done	Time Done	Where Done	Comment
MM/DD/YYYY	Type a value	Select or type a value	Type a value

  

Name	Value	Units
My health history [54128-8]		
Name [54125-0]	Mr good doctor	
Gender [54131-8]	Male	
Birth Date [21112-8]	12/16/1944	{mm/dd/yyyy}
Twin [54132-8]	No	
Adopted [54128-4]	Yes	
Parents related [54135-9]	No	
Body height [8302-2]	70	
Weight [29463-7]	70	
Race [54134-2]	2106-3. White	
Ethnicity [54133-4]	Unknown/No answer	
<b>1.1 Diseases history panel [54137-5]</b>		
History of diseases [54140-9]	Diabetes - type 2 (adult, non-insulin-independent)	
Age range at onset of disease [54130-0]	30-39	
<b>1.2 Diseases history panel [54137-5]</b>		
History of diseases [54140-9]	Congestive heart failure (CHF)	
Age range at onset of disease [54130-0]	OVER 60	
<b>Add another 'Diseases history panel'</b>		
<b>1 Family member health history [54114-4]</b>		
Relationship to patient [54138-7] ?	GRNDDAU. Granddaughter	
Name [54138-3]	Mary	
Gender [54123-5]	Female	
Living? [54139-1]	Yes	
Date of Birth [54124-3]	12/20/1190	{mm/dd/yyyy}
Current Age [54141-7]	Type a number	a
Twin [54121-9]	No	
Adopted [54122-7]	No	

multiple repeats  
per person  
recording

# Survey Score Computed On-the-Fly (PHQ-4)©

Use "List" Style

Use "Table" Style

Show HL7 Message

☐ Display Question Code

☐ Show Help/Description

☐ Keyboard Navigation On  
Input Fields

Total # of Questions: 5

Patient health questionnaire 4 item ©			
Date Done	Time Done	Where Done	Comment
MM/DD/YYYY	Type a value	Select or type a value ▼	Type a value
Name	Value	Units	
— Feeling nervous, anxious or on edge ©	2. More than half the days		
— Over the past 2 weeks have you not been able to stop or control worrying	Not at all		
— Little interest or pleasure in doing things? ©	2. More than half the days		
— Feeling down, depressed, or hopeless? ©	2. More than half the days		
— Patient health questionnaire 4 item total score ? ©	6		

the form  
computes the  
total score as  
one answers the  
questions.

# Choice menu presented as grid from NCBI's database of Genetic variations panel

Simple Small Variants Section				
1 Simple genetic variant panel				
Simple variant		bre		
Transcript specification		Name	Variant ID	Phenotype
Gene studied		NM_015713.4(RRM2B):c.322-2A>G	5387	RRM2B-related mitochondrial disease
Transcript RefSeq ID		NM_000059.3(BRCA2):c.5946delT (p.Ser1982Argfs)	9325	Pancreatic cancer 2
DNA change c.HGVS		NM_000059.3(BRCA2):c.6275_6276delTT (p.Leu2092Profs)	9318	Breast-ovarian cancer, familial 2
Amino acid change p.HGVS		NM_000465.3(BARD1):c.1670G>C (p.Cys557Ser)	8045	Familial cancer of breast
DNA change type		NM_007194.3(CHEK2):c.470T>C (p.Ile157Thr)	5591	Li-Fraumeni syndrome 2
Amino acid change type		NM_007194.3(CHEK2):c.541C>T (p.Arg181Cys)	5597	Familial cancer of breast
Genomic specification		NM_015713.4(RRM2B):c.329G>A (p.Arg110His)	5393	RRM2B-related mitochondrial disease
Genomic reference sequence		See more items (Ctl Ret)		
7 of 8692 total; 2685 bytes in 14 ms				

# Automatic details from hidden fields

## HL7 draft genetic test reporting form

Describes an approach being explored in HL7 Clinical Genomics work group

Genetic analysis overall interpretation		Positive						
Simple Small Variants Section								
1 Simple variants								
Variant ID		Search for value						
Variant name		NM_000492.3(CFTR):c.1400T>C (p.Leu467Pro)						
Variant specifics								
Type	Gene	NM_RefSeq	DNA change	AA change	NC/NG_RefSeq	Ref allele	Allele loc	Alt allele
SNP	CFTR	NM_000492.3	c.1400T>C	p.Leu467Pro	NC_000007.13	T	11719952	C
Allelic Frequency NFR		Type a number						
Cytogenetic location		7q31.2						
Allelic state ?		Select one						
Clinical significance		Select one or type a value						
Possible associated phenotype		Cystic fibrosis						
2 Simple variants								
Variant ID		35830						
Variant name		NM_000492.3(CFTR):c.1684G>A (p.Val562Ile)						
Variant specifics								
Type	Gene	NM_RefSeq	DNA change	AA change	NC/NG_RefSeq	Ref allele	Allele loc	Alt allele
SNP	CFTR	NM_000492.3	c.1684G>A	p.Val562Ile	NC_000007.13	G	11723041	A
Allelic Frequency NFR		Type a number						
Cytogenetic location		7q31.2						
Allelic state ?		Select one						
Clinical significance		Select one or type a value						
Possible associated phenotype		Cystic fibrosis						

# HL7 message generated from completion of genetics form

(only top 2/3ds  
showing)

```
OBR|1|X1000-0^HL7 Genetic Test Panel for Variants - 20160322^LN|
OBX|1|CNE|XXXXX-12^Choose kind of mutations targeted^LN|1|C01^Simple variants^LN~C02^Complex
variants^LN|
OBX|2|CNE|XXXXX-10^Choose region of interest specification^LN|1|C01^Specific targeted mutations^LN|
OBX|3|CWE|51967-8^Genetic disease assessed^LN|1|C0010674^Cystic fibrosis^LN|
OBX|4|CNE|48002-0^Genomic source class^LN|1|LA6683-2^Germline^LN|
OBX|5|CNE|48018-6^Gene(s) examined^LN|1|1884^CFTR^LN|
OBX|6|CNE|51968-6^Genetic analysis overall interpretation^LN|1|LA6576-8^Positive^LN|
OBR|2|XXXXX-9^Simple variants^LN|
OBX|1|CNE|XXXXX-5^Variant ID^LN|1.1|44487^35823^LN|
OBX|2|ST|XXXXX-13^Variant name^LN|1.1|NM_000492.3(CFTR):c.1400T>C (p.Leu467Pro)|
OBR|3|XXXX1-1^Variant specifics^LN|
OBX|1|CNE|XXXXX-19^Type^LN|1.1.1|SNP^SNP^LN|
OBX|2|CNE|48018-6^Gene^LN|1.1.1|44487^CFTR^LN|
OBX|3|CNE|48013-7^NM_RefSeq^LN|1.1.1|44487^NM_000492.3^LN|
OBX|4|CNE|41103-3^DNA change^LN|1.1.1|44487^c.1400T>C^LN|
OBX|5|CNE|48005-3^AA change^LN|1.1.1|44487^p.Leu467Pro^LN|
OBX|6|ST|XXXXX-17^NC/NG_RefSeq^LN|1.1.1|NC_000007.13|
OBX|7|ST|69547-8^Ref allele^LN|1.1.1|T|
OBX|8|ST|X0029^Allele loc^LN|1.1.1|117199525|
OBX|9|ST|69551-0^Alt allele^LN|1.1.1|C|
OBX|3|CWE|X1001-0^Cytogenetic location^LN|1.1|44487^7q31.2^LN|
OBX|4|CWE|X1002-0^Possible associated phenotype^LN|1.1|C0010674^Cystic fibrosis^LN|
OBR|4|XXXXX-9^Simple variants^LN|
OBX|1|CNE|XXXXX-5^Variant ID^LN|2.1|44494^35830^LN|
OBX|2|ST|XXXXX-13^Variant name^LN|2.1|NM_000492.3(CFTR):c.1684G>A (p.Val562Ile)|
OBR|5|XXXX1-1^Variant specifics^LN|
OBX|1|CNE|XXXXX-19^Type^LN|2.1.1|SNP^SNP^LN|
OBX|2|CNE|48018-6^Gene^LN|2.1.1|44494^CFTR^LN|
OBX|3|CNE|48013-7^NM_RefSeq^LN|2.1.1|44494^NM_000492.3^LN|
OBX|4|CNE|41103-3^DNA change^LN|2.1.1|44494^c.1684G>A^LN|
OBX|5|CNE|48005-3^AA change^LN|2.1.1|44494^p.Val562Ile^LN|
OBX|6|ST|XXXXX-17^NC/NG_RefSeq^LN|2.1.1|NC_000007.13|
```

# Form Builder Demo Screenshots

# LHC Form Builder

## Editing LOINC: 72513-5 Vital signs with smoking status and pain scale [VSP]

Form Builder

Save to file Load from file

Title

ADD NEW OR IMPORT FROM LOINC

1 Vital signs with ...

1.1 Body temperature

1.2 BP dias

1.3 BP sys

1.4 Heart rate

1.5 Body height

1.6 Resp rate

1.7 Weight Measured

1.8 Head Circumf OFC ...

1.9 Tobac smoke stat ...

1.10 Pain severity 0-1...

1.9 Tobac smoke stat NHIS [72166-2]

Name	Value	Units
Text	Tobac smoke stat NHIS	
Coding System	LOINC	
Code	72166-2	
Local code	Type a value	
Question instructions	Type a value	
Repeat this item?	No	
Editable	Editable	
Answer required?	No	
Type	List with no exceptions (CNE	
1 Answer item		
Answer text	Current every day smoker	
Answer code	LA18976-3	
Answer label	Type a value	
Score	Type a number	

PREVIEW WIDGET

PREVIEW JSON OUTPUT

Name	Value	Units
Vital signs with smoking status and pain scale		
Body temperature	Type a number	Cel
BP dias	Type a number	mm[Hg]
BP sys	Type a number	mm[Hg]
Heart rate	Type a number	{beats}/min
Body height	Type a number	[in_i]
Resp rate	Type a number	{breaths}/m
Weight Measured	Type a number	[lb_av]
Head Circumf OFC by Tape measure	Type a number	cm
Tobac smoke stat NHIS	Select one	
Pain severity 0-10 Score Reported	Select one	



## After selecting a starter form

list of all of the form questions at the start and their hierarchy

User can add questions or remove levels and re-order questions within a level

Detailed attributes about the current question. In this case, the first one in the hierarchy. Can edit cardinality, skip logic, validation checks etc

Full live form for what has been created so far. Will look just like it would look in real use. This space can also show the JSON output that underlie the form

1 Vital signs, weight, height, head circumference, oximetry, BMI, & BSA panel [74728-7]

Name	Value	Units
Text ?	Vital signs, weight, height, h	
Coding System ?	LOINC	
Code ?	74728-7	
Local code ?	Type a value	
Question instructions ?	This panel was created to co	
Repeat this item? ?	Select one	
Add conditional show/hide logic? ?	No	

1 Vital signs, weight, height, head circumference, oximetry, BMI, & BSA panel ?

Name	Value	Units
SaO2 % BldC Oximetry	Type a number	%
Weight Measured	Type a value	
Head Circumf OFC by Tape measure	Type a number	cm
Bdy height	Type a value	
Bdy height lying	Type a number	Select c
Body temperature	Type a value	
BP dias	Type a number	mm[Hg]
BP sys	Type a number	mm[Hg]
Heart rate	Type a number	{beats}/mi
Resp rate	Type a number	{breaths}/i



- ☐ Clicked on one variable, BP diastolic
- ☐ Shows Controls for managing cardinality
- ☐ Input required
- ☐ Data type
- ☐ Default value
- ☐ Formula
- ☐ Show/Hide rules (Skip logic)

Title

ADD NEW OR IMPORT FROM LOINC

1 Vital signs, weig...

1.1 SaO2 % BldC Oximetry

1.2 Weight Measured

1.3 Head Circumf OFC ...

1.4 Bdy height

1.5 Bdy height lying

1.6 Body temperature

1.7 BP dias

1.8 BP sys

1.9 Heart rate

1.10 Resp rate

1.11 BSA Derived

1.12 BMI

Repeat this item?

Select one

Editable

Editable

Answer required?

No

Type

Decimal

Default answer

Type a value

Units

mm[Hg]

Select one or more or ty

Formula

Select one

Add Restrictions

No

Add conditional show/hide logic?

Yes

Criteria to show this item

Show this item when

Any condition is true

1.1 Condition

Select Source Field

Select one

Add another 'Condition'

# The FHIR connection

## What is working

### □ Using SMART on FHIR

- ❖ Can pull up form service from <https://gallery.smarthealthit.org/>
  - Very fast -- all with native FHIR resources.
  - Provides an ecosystem for LOINC.
- ❖ Steps
  - Pick a patient from the sample patient registry file.
  - Pick a form.
  - Enter data.
  - Store it in the Diagnostic report resource -- using related observations as needed to implement that hierarchical – and repeating – group structure
  - Retrieve it and view it back in the form.
  - Inspect V2 message.
  - Inspect FHIR message.

# LHC-Forms on FHIR

<https://gallery.smarthealthit.org/>

The screenshot displays the SMART App Gallery interface. On the left, a sidebar lists 'Featured Apps' with categories: Recently Updated, Clinical Care, Patient Education, Genomics, Open Source, iPhone and iPad, and All Apps. Below this is a search bar and a list of 25 apps. The main area shows a grid of app thumbnails. The first row includes 'LHC-Forms on FHIR', 'Lush SMART on FHIR App', and 'Meducation RS'. The second row includes 'Meducation TimeView', 'Metabolic Meter', and 'OpenHRE on SMART'. The third row includes 'Patient Education', 'Patient Education', and 'Patient Education'.

**Featured Apps**

- Recently Updated
- Clinical Care
- Patient Education
- Genomics
- Open Source
- iPhone and iPad
- All Apps

25 apps

**LHC-Forms on FHIR**

**Lush SMART on FHIR App**

**Meducation RS**

**Meducation TimeView**

**Metabolic Meter**

**OpenHRE on SMART**

<https://gallery.smarthealthit.org/>

**App Gallery**
BETA
Sign in

🏠 Browse Apps
★ Organizations
🔧 Build an App
📖 About SMART
🔍 Search the gallery

You are here: [Home](#) / [LHC-Forms on FHIR](#)

## LHC-Forms on FHIR

**Author** [Lister Hill National Center for Biomedical Communications \(LHNCBC\)](#)

**Website** <https://forms-demo.nlm.nih.gov>

**Last Update** Monday, October 17, 2016

**Tags** [Clinical Care](#) [Diagnosis](#) [Clinical Data Capture](#) [Featured](#)

[Try It](#)

## App Description

LHC-Forms (a.k.a. LForms) is a light-weight, feature-rich, open-source widget that creates input forms for Web-based medical applications or to integrate into electronic health records (EHRs), personal health records (PHRs), and mobile health apps.

## Related Apps

Other apps by [Lister Hill National Center for Biomedical Communications \(LHNCBC\)](#)

No other items found

<https://gallery.smarthealthit.org/>

Select Sample Patient

Q Search Patients

	Gender	Name	Family Name ↓	Born
<input type="radio"/>	♀	Brittany Ackerman	Ackerman	1942-11-09
<input type="radio"/>	♂	Daniel X. Adams	Adams	1925-12-23
<input checked="" type="radio"/>	♀	Deborah Adams	Adams	1948-01-09
<input type="radio"/>	♀	Emilie Adams	Adams	1935-09-22
<input type="radio"/>	♂	Aaron Alexis	Alexis	1989-10-26
<input type="radio"/>	♀	Carol G. Allen	Allen	1963-12-26
<input type="radio"/>	♀	Beryl Bachmann	Bachmann	1974-02-13
<input type="radio"/>	♀	Paulene Bachmann	Bachmann	1985-02-02
<input type="radio"/>	♀	Magda Bachmann	Bachmann	1937-02-15
<input type="radio"/>	♀	Trudy Belson	Belson	1945-08-30

← Prev 10

Patients 1 to 10 of 176

Next 10 →

1 patient selected

OK

Cancel



## SMART on FHIR Demo with LOINC Panels/Forms

Name: Deborah Adams

Gender: female

DoB: 1948-01-09

ID: hca-pat-18

### Featured LOINC Panels/Forms

US Surgeon General family health portrait

Vital signs panel

Short blood count panel

HL7 Genetic Variant Reporting Panel

HL7 Genetic Variant Reporting Panel (table version)

Please select a LOINC Panel/Form from left side.

Saved Diagnostic Reports

Search LOINC Panels/Forms





# SMART on FHIR Demo with LOINC Panels/Forms

Name: Deborah Adams

Gender: female

DoB: 1948-01-09

ID: hca-pat-18

## Featured LOINC Panels/Forms

[US Surgeon General family health portrait](#)
[Vital signs panel](#)
[Short blood count panel](#)
[HL7 Genetic Variant Reporting Panel](#)
[HL7 Genetic Variant Reporting Panel \(table version\)](#)
[Saved Diagnostic Reports](#)
[Search LOINC Panels/Forms](#)

Save To FHIR Server

Show HL7 Message

Show FHIR DiagnosticReport Content

Use "Label Above" Style

Use "Label on Left" Style

☐ Display Question Code

☐ Show Help/Description

☐ Keyboard Navigation On Input Fields

Total # of Questions: 27

## US Surgeon General family health portrait

Effective Date

MM/DD/YYYY

Name	Value	Units
My health history		
Name	Type a value	
Gender	Select one	
Birth Date	MM/DD/YYYY	{mm/dd/yyyy}
Twin	Select one	
Adopted	Select one	
Parents related	Select one	
Body height	Type a value	[in_i]
Weight	Type a value	kg
Race	Select one or more	
Ethnicity	Select one or more	
1.1 Diseases history panel		
History of diseases	Search for value	
Age range at onset of disease	Select one	
Add another 'Diseases history panel'		
1 Family member health history		



# Issues and Plans

## Issues

- ❑ Observations are all packaged in the Diagnostic report resource.
- ❑ Too slow to move into observation.
- ❑ But currently no option to search by observation ID in that resource.
- ❑ To put them in the observation resource requires requesting a new observation instance ID from that resource, then tying it into the diagnostic report and then storing the observation into the observation resource. With current hardware, it can take 2 seconds per observation. Would not be tolerable to user.

## Issues (2)

- ❑ Lots of challenges with complicated objects whose attributes are treated as individual fields on most real world forms.
  - ❖ Date and time usually entered separately not as one big time stamp
  - ❖ Provider ID entered separately not (usually) as a package with many separate fields.
  - ❖ Telephones etc. rarely entered with all of the paraphernalia.
  - ❖ Even quantities present problems -- easier to use string and regular expressions for many cases (Will make a value- and units object soon)

## To do

- ☐ Link to provider, orders, encounter and depending on which one is chosen pull the other info from that resource.
- ☐ Solve the slow observation store problem.
- ☐ Provide report date and deal better with effective date.

## URLs for exploring

(Ye Wang, Paul Lynch, Ajay Kanduru, Lee Mericle, Clem McDonald)

- ❑ Well-connected data input form (LHC-Forms)
  - ❖ Project page: <https://lhncbc.nlm.nih.gov/project/lforms>
  - ❖ Software download and documentation: <https://github.com/lhncbc/lforms>
  - ❖ Demo site: <https://lhc-forms.lhc.nlm.nih.gov/>
- ❑ Lister Hill Clinical Table Search Service (aka Autocompleter/Table Connector)
  - ❖ <https://clin-table-search.lhc.nlm.nih.gov/>
  - ❖ <http://lhncbc.github.io/autocomplete-lhc>
  - ❖ <https://github.com/lhncbc/autocomplete-lhc>
- ❑ Form Builder
  - ❖ <https://lforms-formbuilder.nlm.nih.gov> (lforms/demo)
- ❑ Units of measure (UCUM) validator and converter
  - ❖ <http://lhncbc.github.io/ucum-lhc/>
- ❑ LHC-Forms on FHIR <https://gallery.smarthealthit.org/>