



The Green Revolution in Health Information Technology

greenCDA

A Standard for Sustainable Health Records

DATE: October 26, 2011

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Hi !

- Introduction
- Health Information Technology: **green**, **yellow** or **brown**?
- HIT Standards: a pivotal role in the **greening** of healthcare
- **greenCDA** and the Revolution in Health Information Technology
 - What is it
 - What is to be done
- Some conclusions and next steps

HIT: green, yellow or brown?

- What's happening today in HIT
 - Hospitals wired for basic administrative functions: “who, where, how much?”
 - Clinical data, the patient record, just coming on to the computer in electronic medical records (EMRs)
 - Outside acute care, Practice Management is in use, narrow adoption of EMRs
- The government would like this to change [1]
 - HITECH
 - Affordable Care Act

HIT: green, yellow or brown?

- As more clinical data moves onto the computer, what impact will this have on the **color** of healthcare?
- Kaiser Permanente study: “Use of Electronic Health Records can Improve the Industry’s Environmental Footprint” [2]
 - Positives:
 - Eliminated 1,000 tons of paper,
 - Eliminated 68 tons of x-ray film,
 - Lowered gasoline consumption by 3,000,000 gallons/year
 - Negatives:
 - Higher energy consumption,
 - Generated additional 250 tons of waste
- Conclusion: net positive impact and the model is useful for evaluating impact

HIT: green, yellow or brown?

- To what extent is KP's experience reproducible?
- KP HealthConnect
 - Implemented March 2010
 - 454 medical offices
 - 36 hospitals
 - 9 states + DC
- Provides
 - Seamless integration of physician offices, hospitals, radiology, lab, pharmacy
 - Secure email between patient & provider
 - Patient review of results, request Rx refills
 - PACS replaced conventional x-ray film in all regions

HIT: green, yellow or brown?

- Study framework
 - Used “Eco-Health Footprint” to identify areas of environmental impact [3]
 - Evaluated impact on
 - greenhouse gases,
 - toxic chemicals, and
 - water use
- Largest effect on greenhouse gases from changes to:
 - paper consumption,
 - energy use, and
 - plastic and electronic waste

HIT: **green**, **yellow** or **brown**?

- Effect of Kaiser's HealthConnect on greenhouse gases through paper use, energy use
- Expressed as equivalent acres of carbon sequestration
- Positive:
 - 4,200 from decreased use of paper records
 - 257 from decreased use of x-ray covers and forms
 - **6,400-9,200 from fewer trips (less gasoline)**
- Negative:
 - 810 from print out of summaries
 - 283 from PC packaging
 - **13,300 from PC and data center power usage**
- Let's focus on these critical factors

How reproducible are the Kaiser findings?

- **6,400-9,200 from fewer trips (less gasoline)**
- HealthConnect:
 - single entity spanning the full spectrum of care
 - Information flowing from clinic to hospital to consultant to lab to patient to pharmacy
- Estimated that in the care of a patient, 80% of the information needed will, at some point, cross an organizational boundary
- Hypothesis: to reproduce the positive impact
 - Information needs to be fluid
 - Organizations must have incentive to maintain quality while reducing visits

HIT Standards: pivotal in the **greening** of healthcare

- **Making information fluid**
- It works at your ATM, and approximately 2.2M other ATMs
- It works for your stock broker, whether the market is +/-
- But, “nobody knows the doctors I’ve seen...” at least, your MDs do not know
 - Who you have seen
 - When you have seen them
 - For what purpose
 - What meds you take, much less OTC and supplements
 - When your last diagnostic test was done, much less the results
 - Unless they themselves have generated this information or, typically, acquired it by phone, fax or _mail.
- Why is HIT so... backward?

HIT Standards: pivotal in the **greening** of healthcare

- **Making information fluid**
- Interoperability
 - “Syntactic interoperability is easy; semantic interoperability is darn near impossible.” Tim Bray, co-editor of XML and one of the first to index the web
- The domain is **BIG**
 - Typical exchange standard might have data dictionary of 10,000 **terms**
 - Just one of the HIT terminologies, and there are dozens in use, has over 250,000 **concepts**
- And expanding
- And relies heavily on narrative – human language – to convey critical information

HIT Standards: pivotal in the **greening** of healthcare

- **Making information fluid**
- So, how do you cope with that level of complexity?
- First wave HIT standards
 - Health Level Seven (HL7) messaging primarily for administrative, lab
 - X12 for claims processing
 - NCPDP for prescription ordering and fulfillment
 - DICOM for images
- What's still missing? The core of the clinical data
 - Discharge Summaries
 - Consult Notes
 - Progress Notes
 - Procedure Reports
 - Diagnostic Imaging Reports
 - History & Physicals

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- **HL7's Clinical Document Architecture [4]**
- **A standard for the exchange of clinical documents**
- **Universal – implemented around the globe**
- **Constrained by rules to fit specific requirements**
 - **Clinical:**
 - **Discharge Summary**
 - **Consult Note**
 - **Imaging Report, etc.**
 - **Public Health: Healthcare Associated Infections**
 - **Quality Reporting**
 - **Clinical Trials**

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CDA: fundamental to national/regional exchange

Germany		SCIPHOX
Finland		Aluetietojärjestelmä
Greece		HYGEIAnet/WebOnColl
Japan		MERIT-9 (MML)
Canada		Infoway
France		Dossier Médical Personnel
Italy		TeleMed Escape
U.S.		CHI, HITSP, IHE
Argentina		Hosp. Italiano de Buenos Aires
England		National Program for HIT
Turkey		National Health Information System (NHIS)

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- **HL7's Clinical Document Architecture**
- **Designated by the Department of Health & Human Services in the US for “meaningful use” of electronic health records**
- **Keystone standard for US healthcare reform**

Minimal Document for Exchange

Good Health History & Physical

Patient	Adam Everyman		
Date of birth	November 25, 1954	Sex	Male
Contact info	17 Daws Rd. Blue Bell, MA 02368, USA Tel: (781)555-1212	Patient IDs	12345 2.16.840.1.113883.19.5
Document Id	999021 2.16.840.1.113883.19		
Document Created:	March 3, 2005, 17:15:04 +0500		
Performer (primary care physician)	Dr. Henry Seven		
Author	Henry Seven		
Contact info	21 North Ave Burlington, MA 01803, USA Tel: (555)555-1002		
Encounter Id	9937012 2.16.840.1.113883.19	Encounter	
Encounter Date	From March 29, 2005 to March 29, 2005		
Legal authenticator	Henry Seven signed at March 29, 2005, 22:44:11 +		
Contact info	21 North Ave Burlington, MA 01803, USA Tel: (555)555-1002		
Document maintained by	Good Health Clinic		
Contact info	21 North Ave Burlington, MA 01803, USA Tel: (555)555-1212		

```

<recordTarget>
  <patientRole>
    ...
    <patient>
      <name>
        <given>Adam</given>
        <family>Everyman</family>
      </name>
    </patient>
  </patientRole>
</recordTarget>

```

Optimum Level: Today

- [REVIEW OF SYSTEMS](#)
- [PHYSICAL EXAMINATION](#)
- [DIAGNOSTIC FINDINGS](#)
- [ASSESSMENT AND PLAN](#)
- [ADVANCE DIRECTIVES](#)

REASON FOR VISIT/CHIEF COMPLAINT

Stomach ache.

HISTORY OF PRESENT ILLNESS

This patient was only recently discharged for a re

He presented to the ER today c/o a dark stool ye
after

Lab at discharge: Glucose 112, BUN 16, creatinin
discharge hematocrit 29%. WBC 7300, platelet co

He was transfused with 6 units of packed red blo

GI evaluation 12 September: Colonoscopy showe

PAST MEDICAL HISTORY

See HPI.

PAST SURGICAL HISTORY

See HPI.

CURRENT MEDICATIONS

1. Lisinopril 5 mg 1 tablet once a day

```
<component>
  <section>
    <templateId root="2.16.840.1.113883.10.20.2.8"/>
    <code
      codeSystem="2.16.840.1.113883.6.1"
      codeSystemName="LOINC"
      code="46239-0"
      displayName="REASON FOR VISIT"/>
    <title>REASON FOR VISIT/CHIEF COMPLAINT</title>
    <text>
      <paragraph>Stomach ache.</paragraph>
    </text>
  </section>
</component>
```


Achievable: Tomorrow

ALLERGIES AND ADVERSE REACTIONS

1. ~~Levaquin~~
2. ~~Lorazepam~~
3. Peanuts

SOCIAL HISTORY

Drug-abuse History: None

Smoking History: 1 pack per day 1972-2000, None 2001-

FAMILY HISTORY

None recorded.

REVIEW OF SYSTEMS

Patient denies recent history of fever or malaise. Positive headaches. Positive for osteoarthritis in hips, knees and l

PHYSICAL EXAMINATION

HEENT

All normal to examination.

HEART

RRR, no murmur.

THORAX & LUNGS

```
<entry typeCode="DRIV">
  <observation classCode="OBS" moodCode="EVN">
    <templateId
      root="2.16.840.1.113883.10.20.1.33"/>
    <!-- Social history observation template -->
    <id extension="123456789"
      root="2.16.840.1.113883.19"/>
    <code codeSystem="2.16.840.1.113883.6.96"
      codeSystemName="SNOMED"
      code="230056004"
      displayName="Cigarette smoking"/>
    <statusCode code="completed"/>
    <effectiveTime>
      <low value="1972"/>
      <high value="2000"/>
    </effectiveTime>
    <value xsi:type="ST">1 pack per day</value>
  </observation>
</entry>
```

Incremental Interoperability

THE MEDQUEST HOSPITAL
DISCHARGE SUMMARY

PATIENT: DOGOOD, LARRY ADMITTED: 1/15/07
MR#: A1234567 DISCHARGE DATE: 2/26/07
ACCOUNT #: 1234567

DISCHARGE MEDICATIONS:
1. ECASA 325 mg po daily (new)
2. Zocor 40mg po daily. (new)
3. Atenolol 100mg po daily (increased)
4. Glucophage 850 mg tab, 1 tab po TID
5. Zyrtec 10mg po daily

DISCHARGE DIAGNOSES:
1. Acute Myocardial Infarction s/p CABG.
2. Cardiovascular collapse
3. Hypertension, NOS
4. Diabetes Mellitus, type II
5. Seasonal Allergies

PROCEDURE: CABG, LIMA->LAD, SVG->Circ, SVG->2/26/07.

HISTORY OF PRESENT ILLNESS: This is a 51 year history of Hypertension and diabetes admitted with chest pain, and hypotension. Please see the H details of admission. He was noted to have non-Q waves and positive cardiac enzymes on presentation and during the hospital stay.

Narrative
Text

HL7 CDA Structured
Documents

```

<componentOf>
  <encapsulatingEncounter classCode="ENC" moodCode="EVN">
    <id root="1.3.6.1.4.1.2835.12" extension="99379127">
      <code code="99213" codeSystem="2.16.840.1.113883.6.12" codeSystemName="CPT-4"
        displayName="Evaluation and Management"/>
    </effectiveTime>
    <high value="20070220"/>
    <low value="20070220"/>
    </effectiveTime>
    <dischargeDispositionCode code="01" codeSystem="2.16.840.1.113883.6.21" codeSystemName="UB92"
      displayName="Routine Discharge"/>
  </encapsulatingEncounter>
</componentOf>
<component>
  <structuredBody>
    <templateId root="1.3.6.1.4.1.11050.10" extension="DMPL_CDAR2_LEVEL1-2REF_US_I2_2005SEP"/>
    <component>
      <section>
        <templateId root="1.3.6.1.4.1.19376.1.5.3.1.3.7" extension="HOSPITAL DISCHARGE DX Template"/>
        <code code="11535-2" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"
          displayName="HOSPITAL DISCHARGE DX"/>
        <title>DISCHARGE DIAGNOSES</title>
        <text>
          <paragraph>1. Acute Myocardial Infarction s/p CABG.</paragraph>
          <paragraph>2. Cardiovascular collapse.</paragraph>
          <paragraph>3. Hypertension, NOS.</paragraph>
          <paragraph>4. Diabetes Mellitus, type II.</paragraph>
          <paragraph>5. Seasonal Allergies.</paragraph>
        </text>
      </section>
    </component>
  </structuredBody>
</component>
  
```

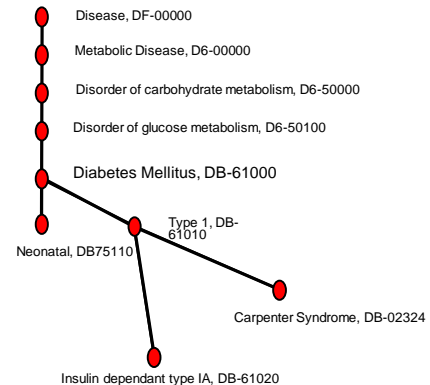
Coded Discrete Data
Elements

EHR
Repository

Clinical
Applications

HIM
Applications

SNOMED CT



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Problem:

Creation of an instance conforming to a particular CDA Implementation Guide (IG) may require knowledge of:

- CDA R2 base specification
- HL7 Version 3 data type specification
- CDA templates defined in that IG
- CDA templates referenced by that IG
- Terminology code lists defined/referenced by that IG;

Validation of an instance conforming to a particular CDA IG may require:

- W3C Schema validation
- Schematron validation

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greenSolution:

Design a simple XML schema:

- Elements use business names (not abstracted);
- Take out the complex stuff required for extensibility

Create the companion transform that will:

- Re-insert static elements
- Transform to canonical CDA elements

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- **greenCDA**

What is it?

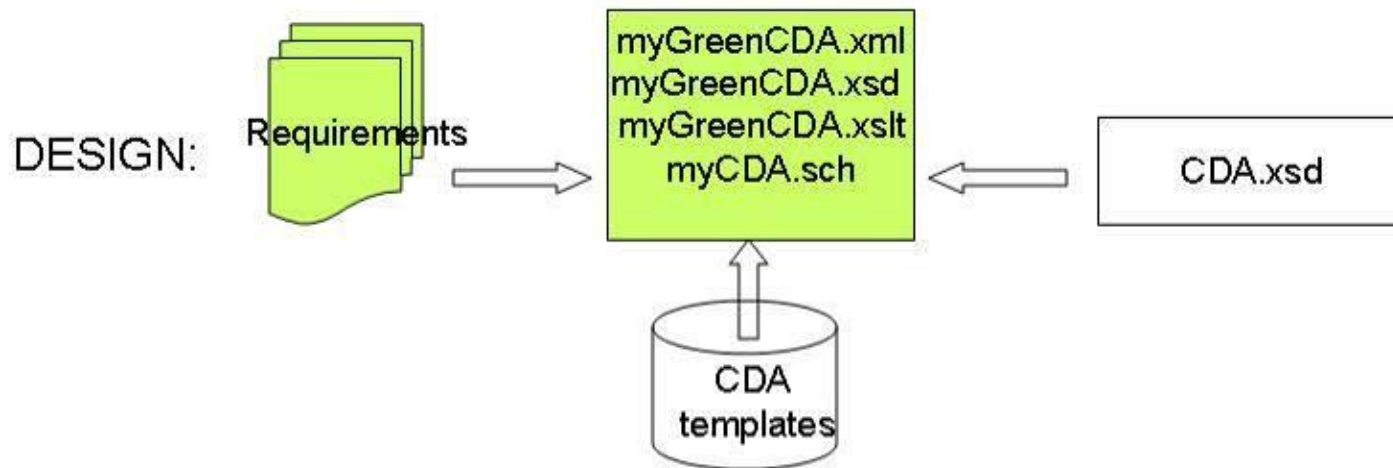
- An implementation methodology for generating templated CDA instances.
- A simplified XML Schema paired with a transform to normative CDA
- An 80% solution

What is it not?

- A replacement for normative CDA

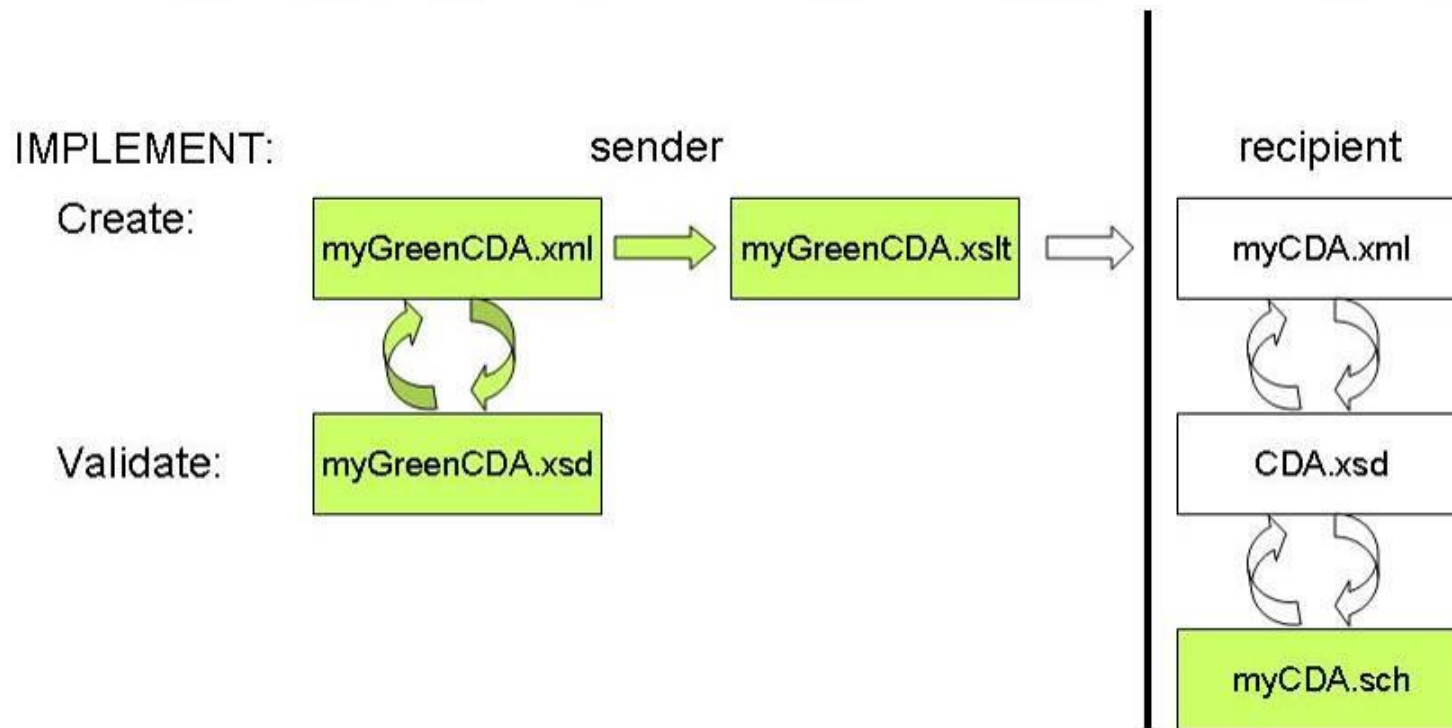
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Complexity remains in design



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Simplicity in implementation



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Simplicity in implementation

```

327 <component>
328 <section>
329 <templateId root="2.16.840.1.113883.10.20.1.2"/>
330 <templateId root="1.3.6.1.4.1.19376.1.5.3.1.3.13"/>
331 <code code="48765-2" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"
332 | | displayName="Allergies, adverse reactions, alerts"/>
333 <title>Allergies, Adverse Reactions and Alerts</title>
334 <text>
335 <table width="100%" border="1">
336 <thead>
337 <tr>
338 <th>Substance</th>
339 <th>Reaction</th>
340 </tr>
341 </thead>
342 <tbody>
343 <tr>
344 <td>
345 <content ID="d22e6">Penicillin</content>
346 </td>
347 <td>Hives</td>
348 </tr>
349 </tbody>
350 </table>
351 </text>
352 <entry>
353 <act classCode="ACT" moodCode="EVN">
354 <templateId root="1.3.6.1.4.1.19376.1.5.3.1.4.5.3"/>
355 <templateId root="2.16.840.1.113883.10.20.1.27"/>
356 <templateId root="1.3.6.1.4.1.19376.1.5.3.1.4.5.1"/>
357 <allergies>
358 <allergy>
359 | | <adverseEventType code="282100009" codeSystem="2.16.840.1.113883.6.96" displayName="Adverse
360 | | reaction to substance"/>
361 | | <product codeSystem="2.16.840.1.113883.6.88" displayName="Penicillin" code="70618"/>
362 | | <reaction codeSystem="2.16.840.1.113883.6.96" displayName="Hives" code="247472004"/>
363 | | </allergy>
364 </allergies>
365 </act>
366 </entry>
367 </text>
368 </section>
369 </component>
370 </entry>
371 </text>
372 <code code="282100009" codeSystem="2.16.840.1.113883.6.96"
373 | | displayName="Adverse reaction to substance"/>
374 <statusCode code="completed"/>
375 <effectiveTime nullFlavor="UNK"/>
376 <low nullFlavor="UNK"/>
377 </effectiveTime>
378 <value xsi:type="CD" code="282100009" codeSystem="2.16.840.1.113883.6.96"
379 | | codeSystemName="SNOMED CT"
380 | | displayName="Adverse reaction to substance"/>
381 <participant typeCode="CSM">
382 <participantRole classCode="MANU">
383 <playingEntity classCode="MMAT">
384 <code code="70618" codeSystem="2.16.840.1.113883.6.88" displayName="Penicillin">
385 | | <originalText>
386 | | <reference value="d22e6"/>
387 | | </originalText>
388 </code>
389 </playingEntity>
390 </participantRole>
391 </participant>
392 <entryRelationship typeCode="MFST">
393 <observation classCode="OBS" moodCode="EVN">
394 <templateId root="2.16.840.1.113883.10.20.1.54"/>
395 <code code="ASSERTION" codeSystem="2.16.840.1.113883.5.4"/>

```


HIT Standards: pivotal in the **greening** of healthcare

- Early results: CDC's National Healthcare Safety Network
 - Launched by CDC in 2005 for surveillance of healthcare associated infections (HAIs)
 - Rapid growth in participation from ~ 300 hospitals initially to over 4500 hospitals in 2011
 - Over 450 hospitals are reporting to NHSN via CDA
 - Initial estimate: **greening** can reduce impedance by up to 10:1



- Use of greenCDA and supporting transformation tools shows great promise as an approach for reducing the effort required to implement fully normative CDA
- CDC worked with the Lantana Consulting Group to develop a greenCDA for central line insertion practices (CLIP) and is exploring the usability of greenCDA for CLIP in vendor systems

HIT Standards: pivotal in the **greening** of healthcare

- So, standards can make the information move, but what if the providers don't *WANT* to minimize visits?
 - Inaugurating pay for quality in healthcare
 - “If you cannot measure it, you cannot improve it.” Lord Kelvin
 - Requires clinical data, not claims codes
- Creating the incentive is as vital as creating the opportunity
- Standards that allow information to move among caregivers, patients and families is essential to both processes

The **greening** of health IT

- Build IT requirements into infrastructure
 - Let's get greater consideration in LEED for Healthcare [9]
 - Let's get greater consideration in the Green Guide for Healthcare
- Realize interoperability through **green** standards
- Reward quality, not quantity

References & Resources

- [1] HITECH: ONC/CMS Final Rules
 - <http://www.gpoaccess.gov/fr/>
 - http://healthit.hhs.gov/media/MU/n508/MU_SCC_CombinedGrid.pdf
- [2] Marianne Turley, Catherine Porter, et.al, “Use of Electronic Health Records can Improve the Industry’s Environmental Footprint”, *Health Affairs*, 30, no. 5 (2011):938-946; online at <http://content.healthaffairs.org/content/30/5/938.full.html>
- [3] Eco-Health Footprint: http://www.globalhealthandsafety.org/workgroups/eco_footprint/
- [4] CDA: <http://www.hl7.org/implement/standards/cda.cfm>
- [5] CDA Academy: www.cdaacademy.com
- [6] **greenCDA:** <http://www.hl7.org/implement/standards/cda.cfm>
- [7] NHSN: http://www.cdc.gov/nhsn/CDA_eSurveillance.html
- [8] Health Story: www.healthstory.com
- [9] LEED for Healthcare: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1765>
- [10] Green Guide for Healthcare: <http://www.gghc.org/>

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