



Experience of the Zato Health Team and the Zato Health Interoperability Platform Processing Electronic Clinical Records to Extract Clinical Quality Measures

Discussion with Connecticut HIT Council

Jan. 15, 2016

Zato Health Team Experience with Computer Assisted Coding and Extraction of Medical Knowledge from Clinical Data

- Dr. Daniel Heinze, Founder and CTO of Zato Health was previously Founder and CTO of A-Life Medical and inventor of LifeCode[®] software
- A-Life and LifeCode[®] were acquired by the largest US health insurer, UnitedHealth in 2010.
- LifeCode[®] is a product of OPTUM – the health services platform of UnitedHealth

LifeCode® - Invented by Dr. Daniel Heinze

- Patented Natural Language Processing (NLP) for computer assisted coding
- Assists medical coders and clinical abstractors by reading clinical documentation
- Deciphers the meaning and context of words within medical records
- Makes sense of doctor/patient interactions
- Correctly codes diagnoses and procedures of patient care for insurance purposes
- Recommends appropriate and compliant ICD-9 and CPT-4 codes
- Reduces the costs of manual claims coding and speeds the reimbursement process
- More accurate efficient coding; enhances productivity
- At the core of OPTUM 360^{0TM} clinical documentation improvement
- Has successfully processed hundreds of millions of medical records

Zato Health: A New Generation of Integrated Software Functionality for Healthcare Data Interoperability

- *Seamlessly integrated software to improve care quality and cost effectiveness*
 1. *Next-Gen **extraction of medical concepts and ICD-10 coding** from diverse clinical data, leveraging a comprehensive medical ontology*
 2. *Data normalization, indexing, **edge processing for de-centralized analysis** across different EHR vendor databases and other healthcare data silos*
- *Improved quality of clinical documentation, billing, performance measures*
- ***Fully verifiable** via links to highlighted evidence in the source clinical data*
- ***Standardized performance reports** to meet payment performance requirements of State, Federal, and private payers*

Zato Health Comprehensive Semantic Ontology

Leveraging relationships among:

- **Clinical anatomy**
- **Diseases**
- **Symptoms, Observations**
- **Medical tests**
- **Findings, Diagnoses**
- **Treatments, Procedures**
- **Morphological abnormalities**

Examples of Healthcare Applications Enabled by Zato Health

- Clinical Documentation Improvement
- Risk stratifying patients
- Automated coding & billing to ICD-10 standards
- DRG Dashboard for proactive monitoring of DRGs
- Patient quality measure reporting (GPRO-EZ)
- Reporting Meaningful Use measures
- Cross clinical and genomic variant data analysis simultaneously
- Effective and efficient search for patient clinical care and audits
- Real time monitoring and quality alerts for evidence based intervention

Extraction and Analysis of Clinical Data from a Cerner EHR Data Repository for a Multi-Hospital Provider

- NLP medical knowledge extraction, coding, indexing of 2.2 million clinical records and millions of lab records of 230,000 patients extracted from Cerner EHR
- Clinical data normalized and indexed for demonstration of DRG Dashboard application and Clinical Documentation Improvement
- HIPAA compliant live demonstrations of capabilities may be arranged upon approval by Baystate and execution of confidentiality agreement.
- Implications for cost savings by further automation of chart reviews
- **Verifiability** of reported data by automatic hyperlinking to evidence
- Low staff requirement and cost for a pilot and evaluation

Extraction of Medical Knowledge from Clinical Data for Correlation with Genomic Data

- Initiative of UCONN Medical School
- De-identification of EHR clinical records, while preserving full fidelity of the medical knowledge in the clinical data. Low site staff time.
- Enabling edge analysis in parallel across outpatient data, inpatient data, diagnoses, medications, imaging studies, test and procedure results, lab and pathology results, demographics, genomic variants
- Objective: to enable discovery of novel genetic variants that are associated with diseases or pharmacogenomics phenotypes
- Extending research data reach to accelerate research discoveries

Additional Zato Team Experience - Anita Karcz MD MBA

- Emergency medicine physician
- Co-founder of Institute for Health Metrics
- VP Product Development InterQual
- Over 20 years innovating with electronic clinical data
- Experience with different EHR vendor systems
- Worked with data from 100 providers to produce clinical quality measure reports, processing over 20 million clinical records in the past 5 years

Dr. Karcz' Use of Electronic Clinical Data for Quality Measures

- Quality initiative experience (MU, IQR, PQRI, etc) from both a clinical and informatics perspective
- Managing/evaluating pilots/projects using electronic clinical data
- Institute for Health Metrics site PI for 4 federal grants:
 - AHRQ-physician practice quality reporting from EMR
 - NCI-comparative effectiveness of therapies for breast cancer,
 - NHLBI-anticoagulation therapy and VTE post total joint replacement
 - CDC-early diagnosis and clinical outcomes in sepsis

**Remaining Slides are not part of the presentation.
They are available for reference during Q&A**

1. Analysis of Clinical Data in the DRG Dashboard Application

Progress Status and Implications

- Live demonstration for DRGs of Pneumonia and Congestive Heart Failure at <https://www.youtube.com/watch?v=93lbgDbc5G0>
- Rank ordered risks calculated for each DRG across patients
- Rank ordered risks calculated for each patient for each DRG
- Easy toggle from dashboard view to source medical record with highlighted evidence
- Easy to use, non-intrusive, highly productive tool for Clinical Decision Support, early intervention, improved outcomes

DRG Dashboard: Productivity for Bundled Payments and Intervention



DRG DASHBOARD

- Pneumonia
- CHF
- AMI
- Arrhythmia
- Atherosclerosis
- COPD
- Cellulitis
- Chest Pain
- Diabetes
- GI
- GI Bleed
- GI Obstruct
- Metabolic
- Other Resp
- Peripheral Vasc
- RBC DO
- Renal Failure
- Sepsis
- Stroke
- Syncope
- TIA
- UTI

Congestive Heart Failure [Clear]

Patient	CHF Dx	CHF diff	BNP	EF	JVD	S3	Rales	Edema
358247113	No	Yes	Yes	Yes	No	No	Yes	No
550098128	No	Yes	Yes	Yes	No	No	No	No
039691597	No	Yes	Yes	Yes	No	No	No	No
081033726	No	Yes	Yes	Yes	No	No	No	No
207560749	No	Yes	Yes	Yes	No	No	No	No
507207992	No	Yes	Yes	No	Yes	No	No	No
333638801	No	Yes	Yes	No	No	No	Yes	No
304946199	No	Yes	Yes	No	No	No	No	Yes
070473543	No	Yes	Yes	No	No	No	No	Yes
933096526	No	Yes	Yes	No	No	No	No	Yes

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Definite Dx (144)
Diff Dx (111)
Indications (107)
Unlikely Dx (476)
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Run query/analytics on selected documents

2. Virtual Data Lake of Clinical and Genomic Variant Records Progress Status and Implications

- Live demonstration of next-gen NLP extraction and edge processing across multiple databases of multiple organizations with data centers in New York and Massachusetts at

<https://www.youtube.com/watch?v=omJfbNLUt90&feature=youtu.be>

- Live demo of fusion of results over multiple private and public networks
- De-identified clinical data and genomic variant data – 8 billion records
- Unified global view from single pane of glass
- Scalability for nation-size virtual data lakes that are interoperable

Navigation of Clinical Records by Facets

The screenshot displays the Zato Health web application interface. At the top, there are navigation tabs for 'Zato', 'DRG Dashboard', and other pages. The main header includes the Zato Health logo and navigation links: DATA SOURCES, QUERY CONTROL, SAVED QUERIES, FOLDERS, and HELP. A search bar contains the query 'tamoxifen AND vcf:vcfexists' and an 'ADVANCED' search button. Below the search bar, there are tabs for 'Analyze', 'Results', and 'Tabular', with 'Results' selected. The results section shows 'Showing 1 - 10 of 37' and a pagination control '1 | 2 | 3 | 4 next'. The results list includes document titles like 'Doc1198.html', 'Doc1187.html', 'Doc1188.html', 'Doc1230.html', 'Doc1190.html', and 'Doc1206.html', each followed by a date and location. The main content area displays detailed clinical notes for the selected document, including diagnoses, medications, and allergies. On the left side, there are several facet filters: 'Add Terms', 'Time' (From/To), 'admission_date' (with years 2005-2006), 'attending' (with doctor names), and 'discharge_date' (with years 2006-2005). Each facet has an 'Apply' button.

Extraction of ICD-9-CM Codes from Medical Records

The screenshot displays the Zato Health web application interface. The browser address bar shows the URL: `demo.zatohealth.com:9180/cg/codeGreen.jsp?storage=session&scenario=3&user=DTH&loadCmd=_NEW_&directory=genomics/ARUP_NA19240_Exome&files=Doc0127_CAC.xml&codes=174.9%7C%7C0093-0782#`. The application header includes the Zato logo, navigation tabs for CODES, E&M, FLAGS, DEMOGRAPHICS, and NOTES, and a Print View button.

The main content area is divided into several sections:

- Document: Doc0127_CAC**
- HEADER**: ARUP_NA19240_Exome | ACMH | 46947625 | | 075014 | 2/16/1997 12:00:00 AM | UNSTABLE ANGINA | Signed | DIS | Admission Date: 2/16/1997 Report Status: Signed Discharge Date: 9/14/1997
- PRINCIPAL DIAGNOSIS**: MYOCARDIAL INFARCTION.
- OTHER DIAGNOSES**: 1. SARCOIDOSIS. 2. HYPERTENSION. 3. NON-INSULIN-DEPENDENT DIABETES MELLITUS. 4. STATUS POST PACEMAKER PLACEMENT. 5. Breast Cancer. S/p right mastectomy. Receptor positive. On Tamoxifen. Recurrence 3 years later to other breast. Then had left mastectomy.
- HISTORY OF PRESENT ILLNESS**: The patient is a 65-year-old female with a history of hypertension, hypercholesterolemia, non-insulin-dependent diabetes mellitus, and with no known hx of CAD admitted with chest pain. She has had several days of exertional chest pain characterized by substernal burning pain which, at times, radiates to the left shoulder. It is sometimes accompanied by shortness of breath without nausea and occasional diaphoresis. She was seen in the Emergency Department with chest pain on June, 1997, with negative troponins and negative cardiac enzymes. An exercise treadmill test on April, 1997, for three minutes revealed a maximal heart rate of 127 and maximal blood pressure of 134/80. She experienced chest pain with 1 millimeter of ST depression in V5 and T-wave inversions in V4-V6. This study was interpreted as consistent with, but not diagnostic ischemia. She was started on aspirin and atenolol. On the morning of admission, she was walking to catch a bus and had an episode of substernal chest burning lasting less than 10 minutes with shortness of breath, but no nausea, vomiting, or diaphoresis. She came by cab to Rirel Carleo And for her scheduled exercise ett/mibi test study and was noted to have T wave inversions in II, III, F, and V3-V6. On arrival to the Emergency Room, the patient was pain free. She denied lower extremity edema and had mild orthopnea which was unchanged. She denied bright red blood per rectum, and stools were black secondary to iron supplementation. Hematocrit on November, 1997, was noted to be 29.3. The patient had been iron supplements since that time. She had a history of colonic polyps.
- PAST MEDICAL HISTORY**: 1) Significant for a history of sarcoidosis. Her last pulmonary test was in April 1995 which showed an FEV1 of 1.61, 72% of predicted; FEV1 ratio to FVC was 80 or 102% of predicted. FVC was 2.01 or 72% of predicted. In the past, she has been treated with prednisone and now uses Ventolin Inhalers p.r.n. 2) History of seizure disorder. 3) Status post pacemaker placement in October 1996 for tachycardia bradycardia syndrome. 4) Status post appendectomy. 5) Status post total abdominal hysterectomy for cervical cancer. 6) Adult onset diabetes mellitus, diet-controlled. 7) History of left calf deep vein thrombosis in 1993. 8) History of colonic polyps with a colonic adenoma diagnosed in 1993.
- MEDICATIONS**: Linsinopril 5 mg q.d.; Pravachol 20 mg q.h.s.; aspirin 325 mg q. day; atenolol 0.5 mg b.i.d.; Dilantin 200 mg b.i.d.; Ventolin Inhaler p.r.n.; ferrous gluconate 325 mg t.i.d.
- ALLERGIES**: Penicillin and erythromycin, gives rash.

The right sidebar displays a list of **Signs/Symptoms/Findings** with associated ICD-9-CM codes and status indicators:

Code	Description	Status
2. 410.91	Acute myocardial infarction Unspecified site; Initial episode of care	Active
3. 135	Sarcoidosis	Active
4. 401.9	Essential hypertension, Unspecified	Active
5. 250.00	Diabetes mellitus without mention of complication; type II or unspecified type, not stated as uncontrolled	Active
7. 195.8	Malignant neoplasm of Other specified sites	Active
9. 174.9	Malignant neoplasm of Breast (female), unspecified	Active
17. 786.50	Chest pain, unspecified	Active
19. 780.8	Generalized hyperhidrosis	Active
20. 459.9	Unspecified circulatory system disorder	Active
22. 786.02	Orthopnea	Active
36. 786.7	Abnormal chest sounds	Active
38. 785.2	Undiagnosed cardiac murmurs	Active
39. 709.2	Scar conditions and fibrosis of skin	Active
41. 790.92	Abnormal coagulation profile	Active
43. 285.9	Anemia, unspecified	Active
44. V58.82	Fitting and adjustment of non-vascular catheter NEC	Active
45. 729.5	Pain in limb	Active
46. 794.31	Abnormal electrocardiogram [ECG] [EKG]	Active
29. 179	Malignant neoplasm of uterus, part unspecified	Active
28. 180.9	Malignant neoplasm of Cervix uteri, unspecified	Active
27. 195.2	Malignant neoplasm of Abdomen	Active
30. 195.3	Malignant neoplasm of Pelvis	Active

The right sidebar also includes a **Documents Currently Loaded** section with a **CLEAR ALL** button and a table showing the loaded document: Doc0127_CAC.

Extraction of Labs, Procedures, and Substances Taken

The screenshot displays the ZATO Health web application interface. The browser address bar shows the URL: `demo.zatohealth.com:9180/cg/codeGreen.jsp?storage=session&scenario=3&user=DTH&loadCmd=_NEW_&directory=genomics/ARUP_NA19240_Exome&files=Doc0127_CAC.xml&codes=174.9%7C%7C0093-0782#`. The application header includes the ZATO logo, navigation tabs (CODES, E&M, FLAGS, DEMOGRAPHICS, NOTES), and a 'Print View' button. The main content area is divided into three sections:

- Document: Doc0127_CAC**: Contains patient information (ARUP_NA19240_Exome | ACMH | 46947625 | 075014 | 2/16/1997 12:00:00 AM | UNSTABLE ANGINA | Signed | DIS | Admission Date: 2/16/1997 Report Status: Signed Discharge Date: 9/14/1997), principal diagnosis (MYOCARDIAL INFARCTION), other diagnoses (1. SARCOIDOSIS, 2. HYPERTENSION, 3. NON-INSULIN-DEPENDENT DIABETES MELLITUS, 4. STATUS POST PACEMAKER PLACEMENT, 5. Breast Cancer, S/p right mastectomy. Receptor positive. On Tamoxifen. Recurrence 3 years later to other breast. Then had left mastectomy.), history of present illness (65-year-old female with hypertension, hypercholesterolemia, and CAD), past medical history (significant for sarcoidosis, seizure disorder, etc.), medications (Lisinopril, Pravachol, aspirin, etc.), and allergies (Penicillin and erythromycin, gives rash).
- Labs/Data/Procedures**: A list of medical codes and descriptions:

Code	Description	Actions
94540	AIRWAY INHALATION TREATMENT	▲▼
93010	ELECTROCARDIOGRAM REPORT	▲▼
93010	ELECTROCARDIOGRAM REPORT	▲▼
36430	BLOOD TRANSFUSION SERVICE	▲▼
94640	AIRWAY INHALATION TREATMENT	▲▼
94761	MEASURE BLOOD OXYGEN LEVEL	▲▼
- Substances**: A list of substances with their codes and names:

Code	Substance Name
0093-0782	tamoxifen citrate
0067-0143	aspirin
0093-0752	atenolol
24451-002	ferrous sulfate
0054-0017	prednisone
21695-198	albuterol
p36100	asthma inhaler
0615-6557	pravastatin sodium
0071-0007	phenytoin
0338-1021	penicillin g
0168-0215	erythromycin
0942-9502	anticoagulant sodium citrate solution
0178-0600	potassium citrate
0071-0417	nitroglycerin
0574-0159	morphine
0093-0154	ticlopidine hydrochloride

Zato Data Security, Tracking, and Accountability for Oversight, Compliance, Auditing, Comparison of Cost Effectiveness

- All Data and indexes remain where the data are created, stored, and protected
- All data access is subject to user role-based discretionary access control
- Optional download encryption and control under Digital Rights Management
- Security enforced and sharing permission controlled at each organization
- Server-to-server security; cross-network data encryption end-to-end
- All user activity is logged at the source for tracking, with global analysis of logs
- Successful financial fraud interdiction in the Intelligence Community processing Suspicious Activity Reports across all US banks under the Bank Secrecy Act
- Successful cross-domain implementation controlling security across multiple security domains and networks in parallel from a single unified interface

Differentiation of Combined Capabilities

- **Data transparency** normalizes, indexes, filters EHR data, HL-7 data, other data
- **Interactive query, analysis** from unified interface ('single pane of glass')
- **Batch analysis:** high productivity, flexible output to reports or other applications
- **Automatic recognition and extraction of medical concepts** 'on the fly' in context
- **Global navigation across data sources in parallel** by context, concepts, facets
- **Current awareness** from continuous monitoring, real-time filtering, alerting
- **Dynamic iterative knowledge discovery and visualization** across data sources
- **Seamless system integration and interoperability** with APIs and Web interfaces
- **Integrated medical ontology, automated medical coding, and medical NLP**

Differentiation of Performance

- **Massive Scalability** across decentralized application repositories, with capacity for scores of petabytes, trillions of records and documents
- **Consistent global relevance ranking accuracy as** data volumes increase and number of nodes increases across data centers
- **Consistent response time performance** as data volumes increase and number of nodes increases across data centers
- **Efficiency over existing networks** with heavy processing loads at the edge
- **Cross-Domain access control security** executed at the edge
- **Unobtrusive** to local production information systems during query and analysis across production data repositories

Zato Health Summary Slide

- Seamless integration of unique next generation capabilities for integrated NLP extraction, ICD-CM-10 coding, semantic medical ontology, edge-processing
- Team track record for new product innovation resulting in improved accuracy, user productivity, scalability, cost savings in massive production systems
- Unique capability to normalize data from multiple EHRs and other health application data silos and enable de-centralized analysis and quality reporting
- Risk stratification capabilities to impact cost effectiveness of healthcare
- Continuous monitoring and discriminating unobtrusive alerts to improve intervention at the point of care and reduce readmissions
- Revolutionary pricing model affordable to every provider with pilot offering and try-before-buy offer for IBM/Zato Power Linux appliance

Contact Information for Questions or to Request a Technical Presentation

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