Transforming validated clinical research into practice using novel EHR integrations within EPIC and Cerner

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Acknowledgements

SIMON MAHLER, MD
Founder
Associate Professor of Emergency Medicine
HEART Pathway Architect and Principle Investigator

SCOTT GILMORE, MD
Founder
Emergency Medicine
Software Design
Medical Informatics and Machine Learning

VINAY TANNAN, PHD
Founding Partner
Medical Devices
Commercialization
Product and Business Development
Overview

• Brief summary of our chest pain research
  – How we solved the problem of chest pain management in the Emergency Room

• Our implementation of CDS into the EHR (traditional method)
  – Lessons learned from going live to data extraction and the pain points

• Creating an iOS Application

• Learning about FHIR and the novel EHR App Store Model
Overview

• Implementation of CDS with the EHR App Store Model

• Data extraction opportunities with the new App Store Model

• Case study on the Cambridge Health Alliance Implementation
Learning objectives

• Understand differences between traditional EHR builds compared to the new App Store model

• Understand why FHIR alone is not a game changer, but addition of EHR App Stores is the transformative aspect

• Understand new research opportunities the EHR App Store Model presents

• Understand how to build a FHIR app and where to start
Chest Pain Problem

5,025
Emergency Departments

8 M
Chest Pain Visits

$13 B
Chest Pain Evaluation

> 50%
Patients Admitted

< 10%
Diagnosed with ACS

2-4%
Missed ACS

U.S. market per year; ACS = acute cardiac syndrome
Grant Funding

Over $2 million in funding supported the development and clinical validation of HEART Pathway

T-32 Training Grant
Randomized Clinical trial Study
Implementation Study
Multi-site implementation study
Multi-site Essay Validation Study
Pre-hospital applications study

Sponsor directives to translate from research to product
PUBLISHED AND VALIDATED

- The HEART Pathway randomized clinical trial: identifying emergency department patients with acute chest pain for early discharge, Circulation 2015 [Link]

- Cost Analysis of the HEART Pathway Randomized Control Trial, AJEM [Link]

- HEART Pathway accelerated diagnostic protocol implementation: prospective pre-post interrupted time series design and methods, JMIR 2016 [Link]

- A multidisciplinary self-directed learning module improves knowledge of a quality improvement instrument: the HEART Pathway, J Healthcare Quality 2016 [Link]

- Adherence to an accelerated diagnostic protocol for chest pain: secondary analysis of the HEART Pathway randomized trial, AJEM 2016 [Link]

- Chest pain risk stratification: a comparison of the 2-hour accelerated diagnostic protocol (ADAPT) and the HEART Pathway, Critical Pathways in Cardiology 2016 [Link]

- Use of the HEART Pathway with high sensitivity cardiac troponins: A secondary analysis, Clinical Biochemistry 2017 [Link]
Results

- **Enhanced Safety**
  - Clinically validated in RCT

- **Reduced Cost**
  - Consistency in sores (improved upon the Heart Score)

- **Better Outcomes**
  - Over 90% physician adherence
Enhanced Safety

Reduced Cost

Better Outcomes

> $7 million cost reduction in two years throughout the health system

*Extrapolated from cost analysis study*

*Results from: Wake Forest Baptist Medical Center*
Enhanced Safety

Dramatic reduction in unnecessary testing

> 12 reduction in length of stay

Reduced Cost

< 1% missed acute cardiac events (Heart Score is < 2%)

Better Outcomes

Transparency in care / discharge plan

Results from: [Wake Forest Baptist Medical Center]
Transforming research into practice

- EHR integration of the tool
- iOS App
- FHIR EHR App Store integration
Development into EHR

• Utilized Implementation Grant
A patient presents to the emergency room with a chief complaint of chest pain.

A contextual alert is triggered in the EHR automatically or manually by the physician.

The physician is presented with the HEART Pathway within the EHR environment.

The physician enters patient history, symptoms and ECG variables into the HEART Pathway.
In seconds, HEART Pathway displays a risk assessment and clinical guidance to the physician and patient team.

The physician cares for the patient using best clinical judgment and HEART Pathway guidance.

HEART Pathway results are inserted into the EHR documentation.
Lessons learned from hardcoding into EHR

• Building initial iteration was surprisingly the easiest aspect

• What was difficult:
  – EHR Versioning
  – Updates, optimizations to workflow
  – Updates to actual protocol
  – Accessing data sets
Exporting Data

• The most difficult pain point – obtaining clean data sets

• Pain Points:
  – Data isn’t stored in a clean method
  – Clarity database
  – SQL
  – Significant FTE usage for Data cleaning and validation
Adherence

• In order to achieve adherence best practices reporting is critical
  
  – Achieved > 90% adherence by performing clinical practice feedback

  – Custom EPIC report writing
    • Dedicated FTE
Transforming research into practice

• EHR integration of the tool

• iOS App

• FHIR EHR App Store integration
Lessons learned from creating an iOS App

- SWIFT
- Analytics tracking
- Great model for testing demand
Transforming research into practice

• EHR integration of the tool

• iOS App

• FHIR EHR App Store integration
Provider Authentication
* EHR bridges single sign-on with FHIR token
* Reduces passwords user needs to remember
* Speeds up the launch sequence

Read Access
* Query discrete observations (labs, PMH, vitals, demographics, etc)
* Incorporate into run sequence
* Improves runtime and accuracy of inputs

Write Access
* Create record in EHR after runtime is complete
* Store results directly in the patient medical record
* Log record of use
Developer ecosystem

Open collaboration → Cerner Open Developer Experience → Connect → Ignite APIs for Millennium → Connect → Create application → Install → Clients

DEVELOPERS

Validated → Publish → app gallery → Discovered and installed

Cerner | code
App Store Model
[Apple / Google Model]
FHIR + App Stores = Transformative
FHIR

EHR Read Access

Physician or Patient Centric App

Database Architecture

EHR Write Access
After validation, EPIC APP Orchard Store

HEART PATHWAY
EHR Apps function “Within” the Chart

- Same iFrame
- Native experience
- Within the workflow
Impathiq

Heart Pathway

Symptoms

Select patient's symptoms:
- Middle- or left-sided
- Pinpoint/well-localized
- Heaviness, pressure, or tightness
- Sharp
- Worse with exertion
- None of the above

ECG Findings
HEART Pathway

Results and Recommendations

Hear Score

3

Low Risk

Recommendation: Your patient has a LOW RISK HEAR score. Please obtain serial troponins at 0 and 3 hours. If serial troponins are negative, the HEART Pathway recommends discharge from the ED without stress testing or angiography.

Clinical Data

The following are present

- Pinpoint/well-localized
- BMI ≥ 30 kg/m²

The following are absent

- Middle- or left-sided
- Worse with exertion
- Radiation to arms/jaw/neck
- Diaphoresis
- Peripheral artery disease
- Currently treated diabetes
- Hypertension
- Repolarization abnormalities
- Nonspecific ST changes
- Pacemaker rhythms
- Early repolarization

- Sharp
- Over 64

- Heaviness, pressure, or tightness
- Relieved by nitroglycerin
- Nausea or vomiting
- Prior stroke
- Smoking in last 90 days
- FH of CAD (1° relative < 55)
- Hypercholesterolemia
- Nonspecific T-wave changes
- Bundle branch blocks
- Left ventricular hypertrophy
- Digoxin effect

Low Risk Handout

Shared Decision Tool

HPI Generator

Save to EHR
* Final Report *

SMART, FRED RICK (71 yrs.)

HEAR Score: 3

Your patient has a LOW RISK HEAR score. Please obtain serial troponins at 0 and 3 hours. If serial troponins are negative, the HEART Pathway recommends discharge from the ED without stress testing or angiography.

Result type: Depart Summary
Result date: October 31, 2017 9:48 AM CDT
Result status: Auth (Verified)
Result title: Heart Pathway Summary Note
Performed by: ImpathQ, PW on October 31, 2017 9:48 AM CDT
Verified by: ImpathQ, PW on October 31, 2017 9:48 AM CDT
**IMPATHIQ SYSTEM ARCHITECTURE**

**Continuously updated and Validated Pathways and Apps**
- HEART Pathway™
- Sepsis
- Patient Safety
- Code Stroke
- Checklist #1
- Compliance Reporting
- Custom Protocols

**Clinical Decision Support**
- Optimization, Custom Reports, Research Opportunities, Machine Learning

**IQ Engine**
- IQ Engine Provides the “handshake” between EMR and Pathways

**Hospital System EMR**
- Epic
- Allscripts
- Cerner

**Actionable health informatics insights pulled from EMR**
- Mobile phone connectivity
- One click reporting for Auditing and Safety
- Accreditation compliance
- Auditing and optimizing EMR pathways
- Interoperable with multiple EMRs
- Plug and Play (FHIR): minimal work required by Hospital’s clinical informatics team
Data Analytics and Insights

Practitioner Compliance

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Score Distribution

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IMPATHIQ
Cambridge Health Alliance Build

• Process

• Time to build

• Transforming validated clinical research into practice

• Adherence tracking

• Clean Data sets
Clinical Performance Analytics

- **Active Doctors:** 46
- **Tested Patients:** 138
- **Hours Saved:** 1,656
- **Overall Savings:** $96,600
Opportunities
What you can do with FHIR

- **Patient Portal**: Patient Feedback / Following up with patients in trials
- **Targeting**: Specific patients for enrollment in trials
- **Multi-Center studies**: (One build crosses platforms, and store in a central database)
- **Creating pathology specific data sets**: (for **machine learning**, research, **AI**)
- **Launching EHR integrated apps for best practice pathways**: (e.g. oncology, cardiovascular protocols)
- **Patient Portal**: Collect survey data or create patient-centric tools via the Portal
Benefits of FHIR and App Stores

- **Scalable** (custom builds for each hospital are no longer required)
- Real time clinical metrics and patient data exportation, dramatically reduce time for cleaning data sets
- Crosses over EHRs (EPIC, Cerner, Allscripts): Perfect for Research
- Rapidly change and optimize clinical protocols without going through hospital informatics team
- Compared to traditional EHR builds, much more cost effective
- Perform integrations remotely and access clinical data remotely
Ability to rethink the EHR experience
Sepsis Huddle App

- Team based sepsis approach
- Dedicated EHR sepsis management
- Checklist driven care
- Instant outcomes reporting and Auditing
Sepsis Huddle App

- Lactate Ordered
- Blood Cultures Ordered
- Antibiotics Ordered
- 30 mL/kg Ordered
- Repeat Lactate Ordered

Has patient been hypotensive?
- YES
- NO

Initial lactate:
- < 2
- 2 - 4
- > 4

Did patient respond to fluids?
- YES
- NO

Reassessment of Volume Status
Sepsis Huddle App

Provider Goals

- Lactate Drawn
- Blood Cultures Drawn
- Antibiotics Administered
- 30 mL/kg Administered
- Repeat Lactate Drawn
- Discuss Volume Status Reassessment w/ Provider

Nursing Goals

Clinical Data

03:21

shock
Sepsis Huddle App

**Mean Arterial Pressure (mm/Hg)**

- **Past 2 Hr**
- **Past 12 Hr**
- **Past 24 Hr**
- **All Time**

- Current value: 108

**Updated a few seconds ago**

**Clinical Data**

- Provider Goals
- Nursing Goals

**Time:** 03:30

**Status:** Shock
FHIR and Clinical Performance Analytics

- Adherence Tracking
- Rapidly optimize clinical protocols
- Clinical throughput tracking
- Incentive driven care
Building a FHIR App in the EHR App Store

- Figure out your scope
- Patient Facing or Physician Facing
- What are the resources you will need to access from the EHR?
  - Labs, vitals, patient demographics, past medical history, social history, medication lists
- What do you want to write back to the EHR?
  - Calculations, decision support, patient feedback
- Is a backend database required?
  - Tracking behavior, results, creating data sets
Building a FHIR App in the EHR App Store

• Basic Skills:
  – HTML / CSS / JS
  – REST API Experience
  – OAUTH Experience

• Advanced Skills:
  – Server-side language (Golang / Node.js / Python / Rust / PHP / Ruby)
  – MS / Linux Server Administration / Architecture Experience
  – Database Architecture / Modeling / Security
  – "Full Stack" developer
Disadvantages of App Stores

- New technology / unfamiliarity
- Complete FHIR specs are not enabled at this time
- Overpromises in the past hinder the present
- Linking triggers in workflow
- No background fetching
THANK YOU

For a FHIR EHR App Store resource

List: iltifat@impathiq.com
Workflow for Hospital Pathways with IQ Engine

Healthcare team Sees Patient

EMR Used by Healthcare team

IQ Engine triggers Intelligently

1. Launches pathway
2. Bidirectional exchange of data with EMR
3. Runs algorithms
4. Gives clinical suggestions

Data is stored for admin use to provide actionable insights.

Data is applied to patient care

PATIENT

Saved in the EMR
Custom Pathways and apps can easily be developed for Hospitals by utilizing the iQ Engine.
IQ Engine gives leadership new tools

- Usage and Adherence tracking
- Populations Health Metrics
- Best practices training and compliance
- Analytics across EHRs
- Analytics across different hospital systems
- Accreditation and reimbursement reporting
## HOW IMPATHIQ EMPOWERS HOSPITAL SYSTEMS

### Clinical Decision Support Pathways
- Evidence Based
- Clinically Validated
- Results Driven

### IQ Engine Informatics
- EMR Interoperable
- Cloud Enabled
- HIPAA Compliant

### Optimizing Healthcare Administration
- Legal Risk
- Consistency
- Accreditation
- Financials
Costs of App Stores

• Ranging from $5,000 to $15,000 for publishing apps

• Costs associated with data transactions

• 20% revenue from sale of apps