Knowledge Management Considerations in Building Decision Support Systems in Healthcare
Across Clinical and Operational Processes

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The Knowledge Management Business Imperative of Healthcare Delivery Organizations

Programmatically develop, acquire and maintain the Electronic Health Record knowledge necessary to deliver meaningful decision support across clinical and operational processes improves quality of care for patients, research, cost-effectiveness, and quality of life for providers.

This includes: Terminologies, Master Data, Order Sets, Templates, and Rules
Managing Knowledge and Building Programmatic Approaches to Achieve Meaningful Use

Structured:
- Order Sets
- Templates
- Rules
- Decision Support
- Drug to Drug Interaction checking
- Pay for Performance
- Adverse Drug Events

Master Data Sets:
- Patient, Provider, Insurance Masters

How will you manage both growth in content and complexity plus growth in business processes and communication?

Structured and Unstructured
- Evidence Based Changes
- Rules, Terminologies
- Review Cycles
- Timelines and Resourcing
- Governance
- Decision Capture
- Content Deployment Planning and Testing
- Archiving for Reuse and Search
Agenda

- The Business Case for Investing in Knowledge Management for Clinical and Operational Data Management Processes
- Models of Governance and Infrastructure for Knowledge Management
  - Linkage of Leadership, Business Drivers and EHR implementation
  - Tools and Infrastructure to support collaborative knowledge maintenance
- Implications of AARA and Managing at the Speed of Change
The Volume and Velocity of Knowledge Processing Required for Care Delivery Grows

Provider: (Expert)
- Medical literature doubling every 19 years\(^1\)
- 2 Million facts needed to practice\(^2\)
- A typical drug order today, decision support accounts for, at most, Age, Weight, Height, Labs, Other Active Meds, Allergies, Diagnoses
- Already, there are 3000+ molecular diagnostic tests on the market (Athena Molecular Diagnostics Order Catalogue), genomics and personalized medicine will increase the speed of change of evidence exponentially

Enter the Patient:
- Non clinical expert contributing to their Medical Record
- Maintenance of PHRs
- See Multiple providers, receive multiple tests, across many organizations

How does an organization manage and adapt to change so that the right decisions are surfaced at the right time to maintain quality healthcare – from a clinical and operational perspective?

\(^1\)Don Detmer
Pay for Performance has increased focus on clinical decision support embedded in EHRs.
Incentives and Drivers: Part 2
Meaningful Use Creates New Incentives for Smarter EHRs

Meaningful Use

Overview
The American Recovery and Reinvestment Act of 2009 (Recovery Act) authorized Centers for Medicare & Medicaid Services (CMS) to provide reimbursement incentives to eligible professionals and hospitals who are successful in becoming "meaningful users" of certified electronic health record (EHR) technology. The Medicare EHR incentive program will provide incentive payments to eligible professionals (EPs), eligible hospitals, and critical access hospitals (CAHs) that are meaningful users of certified EHR technology. The Medicaid EHR incentive program will provide incentive payments to eligible physicians and hospitals for efforts to adopt, implement, or upgrade certified EHR technology or demonstrate meaningful use in the first year of their participation in the program and for demonstrating meaningful use during each of five subsequent years.

Rule Development
On December 30, 2009, CMS announced a notice of proposed rulemaking (NPRM) implementing provisions of the Recovery Act that provide incentive payments for meaningful use of certified EHR technology. The proposed rule outlines provisions
Today’s EHR Solutions Inadequate for Strategic Knowledge Management

- Master Data Management Best Practices are not implemented out of the gate

- Task-interfering mode of clinical decision support

- Editors “silo-ize” content, don’t support provenance, versioning, life-cycle, propagation, discovery or maintenance

- No support for the front-end governance, drafting, decision making process required to design the knowledge – Best Practices further siloed

- Consequently, clinical systems implementations are under-resourced with adequate knowledge to meet research, safety and quality needs

- Labor of developing and maintaining Clinical Decision Support knowledge is vastly underestimated
Key Considerations – Building Decision Support Systems

- Role of Governance
- Process and Data Management
- Systems – ties to complexity
- Discipline of the Organization
- Maturity of Organization – How do they see themselves
- SMEs how do they rule the roost? (sharing, hoarding, etc)
- Investment in IT – where has the organization invested – what is the tool set to work with? (Build, Buy or Reuse?)
What follows is:

1. A Case Example of Managing Clinical Decision Support Knowledge

2. A Case Example of Managing Operational Decision Support Knowledge
Partners HealthCare

- Founded in 1994
  - Brigham and Women’s Hospital
  - Massachusetts General Hospital
- Now includes:
  - Community physician network – 1000s
  - 2 rehab hospitals
  - 4 community hospitals
  - Affiliated cancer hospital
- Enterprise Clinical IT supported by Partners Information Systems
  - 1100 employees
  - Almost 60,000 email accounts alone
  - 5 Internally Developed CPOE systems sharing medication services decision support
  - 3 flavors of Meditech, 1 Siemens Site
  - Thousands of MDs using CPOE
Partners Healthcare System made a Strategic Investment in Clinical Knowledge Management

- Create a foundation for knowledge discovery and personalized medicine

- Reduce the cost and increase speed of translation of evidence and innovation into clinical decision support
  - Cost of not having the decision support
  - Cost of delayed update of decision support
  - Liability of incorrect CDS recommendations or inconsistent safety net firing

- Enable collaborative, federated knowledge development ensuring stakeholder involvement and adoption

- Harmonize clinical definitions and knowledge across care delivery, quality measurement, and clinical research systems

- Ensure knowledge assets are aligned with business drivers - Personalized Medicine, Translational Medicine, Quality Reporting, Research, Pay-for-Performance
Partners has a long track-record in applied clinical decision support

- Physician-oriented Drug-Drug Interaction Checking
- Inpatient interactive order rules and notification alerts
- Inpatient template orders (hundreds)
- Proactive Dosing support for Geriatric, Pediatric, Neonatal, Renally-Impaired, and Heme-Onc populations
- Radiology Ordering decision support
- Preventive health reminders
- Documentation templates
- Disease management reports/dashboards (Diabetes, others to follow)
- Outpatient drug-lab, drug-disease interactive reminders
Knowledge Life-Cycle Challenges For Most Healthcare Organizations

Committee, Department, Researcher, or Other Proposes to Implement Content

Guideline is Defined and Validated

- Governance and Stewardship poorly defined
- IT not aligned with Quality Management
- Which HEDIS or JCAHO measure do you focus on first?

Functional Knowledge Specification For Encoding is Designed and Validated

- Inadequate tools and personnel to support vetting and update of knowledge
- Physicians don’t have time for meetings
- Nursing and Pharmacy resources are precious, also no time for meetings
- Lack of transparency of knowledge already in production
- Bottlenecks the time it takes to agree on content

Specification is Engineered into Production Generating a Technical Specification

- Project and resource competition with other engineering projects, prioritization processes unclear
- Editors inadequate

Ongoing Revisions or Eventual Sunset Of Encoded Guideline

- Lack of access to analytic data available on decision support content or impact on clinical outcomes impact to direct updating
- No content management tools to support process and ensure timeliness
Knowledge Analysts facilitate Knowledge Design in EHR

Knowledge Editors Author Decision Support Knowledge

Production Knowledge Repositories

Governance and Content Committees: Prioritizes and Sponsors Operational Stewardship of Content

Safety | Quality | Disease Management | Trend Management

Primary Care | Disease Areas | Pharmacotherapy | Imaging Studies

SME Groups

Adult, Geriatrics, Pediatrics, OB/Gyn

CAD/CHF, Diabetes, Heme-Onc, Asthma, ID/HIV, Nephrology, Psychiatry

Medication Knowledge Committee | Outpatient P&T

MGH | BWH
Develop a Program: Clinical Knowledge Management

- Collaboration sites support COP around the governance structures and priorities (Diagnoses, Diseases, Safety, Trend-Management, some are site-specific, some are enterprise-wide)

- Content assets: dictionaries, population definitions, rules, order sets, documentation templates, care plans, quality management reports, and the like

- Issue tracking and scheduling of the update-process, assigned accountable owners of the “list” to manage and drive updating and reporting

- All design decisions are retrievable (who, what, when, why, due date for update, status of implementation)

- Track labor and duration of maintenance
Partners maintains a geriatric dosing database that supports either default dosing more appropriate for geriatric population or substitution recommendations.
Welcome back to the Gerios v2 eRoom

Action items:
1. Finalize Narcotics.
2. Finalize Antipsychotics.
3. New therapeutic categories:
   a) Cardiac Medications (Round 1 due Oct 7)
   b) Sedative Hypnotics (Round 2 due Oct 7)
   c) Anticholinergic Drugs (Round 1 due Oct 7)

If you have any questions or comments, please contact Eileen Yoshida 781.416.5502.

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<thead>
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<th>Owner</th>
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<td>Eileen Yoshida</td>
<td>1 item</td>
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<td>30 Sep 04 3:15pm</td>
<td>Judy Coleohi</td>
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## NSAIDs database

A database created by Severino Masugle on 10 Sep 04

**show search** *(all 24 entries shown)*

Welcome to the Gerlos eRoom.

<table>
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<th>Roll-Up Name</th>
<th>Route</th>
<th>LEDCOMP Reference</th>
<th>Current BICS FQC</th>
<th>Current BICS Min. Dose</th>
<th>Current BICS Max. Dose</th>
<th>Current BICS PSt. Dose</th>
<th>Current BICS Substitute Meds</th>
<th>Current BICS Substitute Notes</th>
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<td>DECOPTENAC SODIUM</td>
<td>PO</td>
<td>...Use lowest effective dose for shortest period possible...</td>
<td>BID</td>
<td>25 MG</td>
<td>75 MG</td>
<td>25 MG</td>
<td>IBUPROFEN, PO (#369)</td>
<td>Instructions equally pc ibuprofen expensive substitute</td>
</tr>
<tr>
<td>IBUPROFEN</td>
<td>PO</td>
<td>...Use lowest effective dose for shortest period possible...</td>
<td>Q6H, PRN</td>
<td>200 MG</td>
<td>800 MG</td>
<td>400 MG</td>
<td>IBUPROFEN, PO (#369)</td>
<td>Instructions equally pc ibuprofen expensive substitute</td>
</tr>
<tr>
<td>IBUPROFEN</td>
<td>PR</td>
<td>...Use lowest effective dose for shortest period possible...</td>
<td>Q6H, PRN</td>
<td>400 MG</td>
<td>800 MG</td>
<td>400 MG</td>
<td>IBUPROFEN, PO (#369)</td>
<td>Instructions equally pc ibuprofen expensive substitute</td>
</tr>
<tr>
<td>INDOMETHACIN</td>
<td>PO</td>
<td>Best to start older adults on 25 mg dose given 2-3 times/day.</td>
<td>BID</td>
<td>25 MG</td>
<td>50 MG</td>
<td>25 MG</td>
<td>IBUPROFEN, PO (#369)</td>
<td>Instructions equally pc ibuprofen expensive substitute</td>
</tr>
<tr>
<td>INDOMETHACIN SUSTAINED RELEASE</td>
<td>PO</td>
<td></td>
<td>QD</td>
<td>75 MG</td>
<td>75 MG</td>
<td>75 MG</td>
<td>IBUPROFEN, PO (#369)</td>
<td>Instructions equally pc ibuprofen expensive substitute</td>
</tr>
<tr>
<td>PIROXICAM</td>
<td>PO</td>
<td>Some clinicians have used 10 mg every other day to initiate therapy in older adults to help avoid side effects and produce effect at slower dose.</td>
<td>QD</td>
<td>10 MG</td>
<td>20 MG</td>
<td>10 MG</td>
<td>IBUPROFEN, PO (#369)</td>
<td>Instructions equally pc ibuprofen expensive substitute</td>
</tr>
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</table>
IBUPROFEN

Route: PO

Leucamp Reference: ...Use lowest effective dose for shortest period possible...

Current BCS FQC:
- Min. Dose: 200 mg
- Max. Dose: 800 mg
- Pref. Dose: 400 mg

Current BCS Substitute Meds

Comments:

Suggest regular, not prn, treatment for 5-7 days and then re-evaluate.

Agree (Jatin Dave, 30 Sep 04 11:21pm) 1

Round 1 Summary (Oct 18) (Elleen Yoshida, Partners Healthcare, 18 Oct 04 4:00pm) 1
1. Agreement on min dose, max dose and preferred (default) dose.
2. Re: frequency - suggestion made to change to q6h (NOT q6h prn) for better pain management. In addition, in LWR, we technically, we default to q6h dosing, therefore, must use q6h.

I would like to see max dose at 600mg (James Rudolph, 26 Oct 04 8:51pm) 1
However, I can be easily persuaded to keep it at 800.

Ibuprofen (Andrew Sager, 29 Oct 04 8:55am) 1
Default Dose = 400 mg every 6 hours; current labeling says max is 3200 mg daily;
max dose = 800 mg max frequency Q6H = 2400 mg QD

Round 2 Summary (Nov 14) (Elleen Yoshida, Partners Healthcare, 15 Nov 04 10:56am) 1
1. Still need to finalize max dose of ibuprofen.
2. I will try to pull (and post) Ann Rheum Ds 2004 reference to see if this is helpful.
Votes

Agree with Claus (Andrew Sager, 18 Nov 04 10:37am)
Recommended starting dose of 200 mg 3 times a day.

Still nervous about the max dose (James Rudolph, 18 Nov 04 9:20pm)
My thought is that if 240mg of ibuprofen a day is not working, the incremental benefit is not going to be outweighed by the risks - especially in the elderly.

200 mg is the OTC dose, I think the Rx default (starting dose) should remain at 400mg Q8h.

I agree that ibuprofen should be our 'Go-To' drug and top the list. The other on the list can be naproxen (second on the list, but still cheap and effective for pain)

Poll (Eileen Yoshida, Partners Healthcare, 7 Dec 04 8:49am)

What should the max (single) dose be?

3 votes cast

Final round summary: (Eileen Yoshida, Partners Healthcare, 7 Dec 04 8:51am)
1. Complete the vote above to determine the max (single) dose of ibuprofen.
2. Note the frequency is currently set at q6h and I believe ibuprofen is usually dosed q4-6h. However, re-reading our discussion on ibuprofen, I see that q8h has been entertained. Post only if you want the frequency changed to q8h.

I would prefer q8h as standard frequency (James Rudolph, 14 Dec 04 9:15am)

Max Single Dose Ibuprofen (Andrew Sager, 15 Dec 04 8:16am)
While the max daily should be 800 mg, the maximum frequency should be as Jim indicates 3 times a day for a max daily dose of 2400 mg.

Please clarify (Claus Hamann, Partners Healthcare, 16 Dec 04 6:39am)
I thought that the cutoff between low and high daily doses of ibuprofen was 1200 mg, so our rec. max. daily dose is 1200 mg / 400 mg TID. Jim, is there literature to support q8h vs. q6h?

I agree with Jim on maximum dose of 600 for an average older patient (John Dave, 16 Dec 04 9:16am)

Summary Dec 17 (Eileen Yoshida, Partners Healthcare, 17 Dec 04 11:59am)
It looks like the majority of the group would like q8h dosing. Therefore, have changed frequency from q6h to q8h. Now that we have picked a frequency:
  a) default dose = 400 mg q8h - sounds like we are pretty comfortable here
Summary Doc 17 (Eileen Yoshida, Partners Healthcare, 17 Dec 04 11:39pm)

It looks like the majority of the group would like Q8H dosing. Therefore, have changed frequency from q6h to q8h. Now that we have picked a frequency:

a) default dose = 400 mg q8h - sounds like we are pretty comfortable here
b) min dose = 200 mg q8h - haven't seen anyone challenge this

According to Lexicomp's geriatric reference (which makes no distinction between adult and geriatric dosing), max dose for inflammatory disease is 3.2 g/24 h; max dose for pain/fever is 1.2 g/daily.

This is an important one to be comfortable with, since we are recommending ibuprofen in most cases.

Post only if you disagree with above.

Max Daily Dose (Andrew Sezer, 17 Dec 04 12:49pm)
800 mg 3 times a day is 2.4 grams daily

400 mg q8h (Claus Hanann, Partners Healthcare, 17 Dec 04 1:22pm)

Max Daily Dosing (James Rudolph, 21 Dec 04 1:53pm)
The maximum single dose should be 800mg.
The recommended dosing is 400mg Q8h.

Again, I would like to see the max dosing at 800 mg q8h (1800mg/day). This is based on the renal excretion of ibuprofen and declining renal function in older pts.

However this appears to be inconsistent with the max single dose (800mg) which I believe is important to keep for acute inflammatory conditions (gout, OA flare, post LP Headache, etc). We are referring every other drug to ibuprofen and treating acute pain is probably more important than the other risks (GI bleed, Renal Failure, HTN, etc)

Therefore, my vote is that the max daily dosing should be 800 mg q8h.

agree (Jatin Dave, 18 Mar 05 6:08pm)

Supporting Documentation

Please see bolded text. References for Ibuprofen / NSAIDS

00000652-20040700-00002.pdf
Versions and notes can be reviewed to track changes over time and rationale for changes to the order set specification.
Each night, a summary of the day’s activities in the room arrives in the panel member email inbox. Each topic is a hyperlink to that point in the eRoom to facilitate efficient participation and navigation to the questions at hand.
After updating the content in the medication knowledge base, updates are published quarterly to the portal to share across sites…
The Organization: Emory Healthcare

- Emory Healthcare is the largest healthcare system in Georgia – providing primary and acute care services
- We are ranked in the top 50 hospitals in 2009 by *U.S. News & World Report* in 11 specialties:
  - Ophthalmology
  - Psychiatry
  - Geriatrics; Heart and Heart Surgery
  - Neurology and Neurosurgery
  - Ear, Nose and Throat
  - Kidney Disease
  - Diabetes/Endocrinology
  - Gynecology
  - Urology
  - Cancer

Additional Facts about Emory

- We have approximately - 30 health centers
- We have approximately 1,200 beds
- We employ -- approximately 10,000 employees serving the metro Atlanta area
- Emory Healthcare is the clinical arm of the Robert W. Woodruff Health Sciences Center of Emory University, tied to the Emory University School of Medicine.
Current Challenges: Improving Patient Access and Reduce Operational Costs

Emory, like many health organizations:

Has no shortage of data, residing in different applications

The organization’s focus for improvement:

Improve Operations, Data Management and Streamline Processes for Patient Registration and Billing

To achieve the objective – the organization had to look at their people, processes, systems, and data

Develop Operational Decision Support to ensure Best Practice was being followed – costs sky rocket with out this stewardship

Systems:

3 Registration systems and 2 Billing applications
Current Challenges: Patient Access

Data Issues:
Data models for Patient level and Encounter level data for Inpatient and Outpatient settings are not aligned at the Patient Level.

When the data is interfaced to across multiple billing and registration systems it requires lots of human intervention and scrubbing to be accurate

Process Issues:
There are 3 separate systems for Registration and 2 Billing system – each with varied processes that support registration and data management
Current State Challenge: Big Picture

Radiology, Surgery, Other Specialties

Registration System A

Registration System B

Registration System C

InPatient

OutPatient

Register

Register

Register

With Multiple Data Models for Patient Level and Encounter Level Data
Sharing requires lots of Data Scrubbing by Humans Especially in the Billing Applications Areas

Billing System B

Billing System C

Interface Registration Data to other Registration systems

Interface Registration Data to Billing Systems

Search for Patient

Registration

Insurance validation

Insurance exception processing

Arrive
• **Patient Access:** Registration process breaks into 5 main components

  - **Search and Selection of the Patient** (Determines if the patient is New or Existing)
  - **Patient Registration (excluding the encounter)** is broken down into 2 Components:
    - Collection of Patient Level Demographic Information
    - Collection of Patient Level Insurance Information
    - Validation and Exception Processing of the Collected Data – Insurance and Demographic
  - **Arrival of the Patient**

  *During the course of the Project Over 100 processes and hundreds of human decision pathways were analyzed and normalized for each segment of registration - to determine where decision support should be applied in the process*
What are the Opportunities for Change to Improve Patient Access?

Opportunity 1:
Clearly define Business objectives, goals and align to roles in the Registration Process
Move to an assembly line model with clear handoffs and measurement

Opportunity 2:
**Improve Patient Search and Patient Selection** – Provided a Guided option to drive out redundant and inefficient searches

Opportunity 3:
**Optimize Business Process, Data Validation for Data Entry for Registration and Insurance Validation**
- Automate where Possible Insurance Validation using appropriate tools
- Provide a Clear Status Insurance Data Validation
- Provide clear guidance with decision support – hard and soft stops
- Provide Work Queue Exception Processing across Registration and Insurance Validation
- *Reduce the number of times the information is keyed and rekeyed*

Opportunity 4:
**Standardize and Organize Data Model and Capture for Patient Registration**
Search and Selection of a Patient

Process:

Start

- Scheduling Tool
- RadNet
- SurgiNet
- CVNet

Scheduler keys required data elements in Millennium search screen

Search is executed in Millennium

Weighted average result set is returned to the operator with guided search option

Patient is located from the result set or Guided search option is used to further refine the result set.

Determination is made from the refined search result set if this is a new patient (Do they exist in the Database?)

New Patient

Complete Registration - New Patient Process

Existing Patient

Complete Registration - Existing Patient Process

Data Model:

One unique identifier is required plus last name, first name, DOB, & gender

Driver's License or MRN or SSN (Last 4 Digits) or Passport # or Military Id or Visa Id or Green Card #

Last Name (as it appears on Driver's License) and First Name (as it appears on Driver's License) and DOB and Gender

Required Data elements to search patient?
Collection and Validation of Patient Level Demographic and Insurance Information

Process:
Collection and Validation of Patient Level Demographic and Insurance Information

**Data Model:**

<table>
<thead>
<tr>
<th>Data Model</th>
<th>Patient Level Insurance</th>
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<tbody>
<tr>
<td><strong>Patient</strong></td>
<td><strong>Insurance</strong></td>
</tr>
<tr>
<td>Demographic</td>
<td>Elements to Launch Med’c*Connect (270)</td>
</tr>
</tbody>
</table>

- Patient Name
- Patient DOB
- Gender
- Insurance Member ID
- Insurance company Name
- Insurance Plan
- Primary Insurance
- Secondary Insurance
- Additional Insurance sources

* (Exception): Tricare and Humana do not require Certificate Id. They require SSN. In this case Certificate Id will be replaced with SSN.
Patient Arrival

Process:

Data Model:
Rising to the Challenge: People, Process, Systems and Data Management
Getting the Big Picture
Core Technologies to support Decision Support and Process Management

- Application 1
- Application 2
- Application 3
- Application n + 1

Electronic Health Record/Patient Management

Rules Engine

WSDL Tool Box
Get and Post

Process Orchestration Management (BPM)

Work Queue Management

Context Management
Carefx

Event Cloud:
- Publish and Subscribe
  - Published HL7 Events
  - Custom Events

Electronic Health Record/Patient Management

Application 1
Application 2
Application 3
Application n + 1
The Solution

Agile Frameworks are Fundamental

1. Single Patient Registration System and Data Model

2. Registration System - Patient Management

3. Automate Validation of Insurance

Only true validated data is Interfaced Billing Systems Reducing Scrubbing on Back end

Billing System B InPatient

Billing System C OutPatient

Work Queue Management Supports Exception Processing

Registration Exception Processing and Clean up

Insurance Validation Exception Standard Insurance

Insurance Validation Exception Non Standard Insurance

Enterprise Content Management, BPM and Context Management
Solution Benefits

- We established a single data model and single system for Patient Registration across inpatient and outpatient applications and settings
- We streamlined workflow and provided through decision support by which registration occurs and clearly identified exception processing parameters
- We automated exception processing -- no paper reports and tribal knowledge to get things done -- instead we use true work queue management for exception processing of our mission critical data
- We established reporting and transparency for exception management – for improved tracking and management
- As a result, we have the improved the health of our data supporting registration, patient care and billing
- Streamlined application and data management for patient registration across Emory’s Hospitals and Clinics
Questions or Want to know how to get started?

Contact:
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617.513.0334