Readmission Analytics:
Care Transformation through Innovation and Analytics

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Care Stages and Readmission
- Focus is on Continuity of Care

Stage 1

Stage 2

Stage 3

Stage 4

Pre-Hospital

Outside Patient Room

Patient Room

Post-Hospital
Patient Care Life Cycle & Readmission

Problem Environment

- Stage 1
- Stage 2
- Stage 3
- Stage 4

Diagnosis and Treatment Decisions

Sustaining Environment

Pre-Hospital

Outside Patient Room

Patient Room

Post-Hospital
Continuity of Care - Looking through readmission lens

• Innovations to
  • Improve care outside the hospital
  • Improve care within the hospital to reduce readmission
  • Reduce the need for admission in the first place
Ideal Discharge Planning

Discharge planning
1. Complete communication of information
2. Medication safety
3. Educating patients to promote self-management
4. Enlist help of social and community supports
5. Advance care planning
6. Coordinating care among team members
7. Monitoring and managing symptoms after discharge
8. Outpatient follow-up

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Case studies

**Study 1**: Ascension/Crittenton – Nursing Home

**Study 2**: St Joseph Mercy – RSVP

**Study 3**: Henry Ford HS – Postal workers (based on a UK model)

**Study 4**: Infomediary – health exchanges for knowledge sharing

- Innovations that
  - Encourage partnership with external care providers
  - Encourage patients to self-manage their care post-discharge
  - Shift some post-discharge responsibilities to inside the hospital
Study 1: Role of Intermediaries at Nursing Homes

While CMS is supporting the effort now, one needs incentive models for hospitals, SNFs or insurance companies to support the role of the intermediary.
Study 2: Role of an intermediary at home (study on-going)

EMTs (emergency mgmt. technicians) visiting patients at home

Select patients were given a wrist monitoring device to track vital signs

Provide an iPAD connected to hospital to enter certain information like weights

EMTs visit at some regular intervals to check on patient conditions

Hospital is paying for the time EMTs spend and is exploring viability of this option in the long run for potential expansion

Penalties for early readmission (cost of patient stay in the hospital not reimbursed), quality reputation (patient satisfaction)
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Knock and Check

Fashioned after Call and Check of UK

Letter carriers visit the homes of frail seniors, who live along their route, to check on their well-being. Led by Henry Ford Global Health, Knock & Check hopes to partner with the post office to conduct these visits.

Utilizing existing workforce capacity (like letter carriers) to conduct short in-person weekly visits with frail seniors is an exciting innovation with the potential to reduce isolation and improve health.

Study 3: Role of an intermediary at home (study in pilot phase)
Study 4: Infomediary to Support Knowledge Sharing

- **Active users** are two times more likely to stay than leave in the short term. Activity keeps users engaged for a short time span, but it may not sustain their engagement with the infomediary over time. Need intervention to keep them engaged.

- **Non-active users** maintain a status-quo in short run and gradually move to the “leave” state from the infomediary in the 8 weeks’ period.

- “Questioning” activity leads to the highest probability that a user will stay engaged both in the short and long run.

- Furthermore, users seeking information on diverse and multiple numbers of topics have a higher propensity to stay than users asking questions around a single theme.
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Study 5: St Joseph Mercy - Intelligent Care Systems
  Escalation protocols
  Digital services to reduce fall risk, hospital acquired infections, and glycemic control
  Getwell networks
  Inter-professional rounding
  Risk based proactive nurse engagement
Study 6: U of Vermont/Stanford – Operating room
Study 7: St Joseph Mercy – ER
Study 8: CHIP and other innovations

• Innovations that
  • Encourage partnership with external care providers
  • Encourage patients to self-manage their care post-discharge
  • Shift some post-discharge responsibilities to inside the hospital

• Holistic approach to patient care
  • Collaboration of care coordinators
  • Patient education and communication
  • Get post-discharge care coordinators engaged in patient care in the hospital
  • Analyzing team-work in operating rooms
  • Analyzing patient flow analysis in ER
• Reordering processes as a part of pre-medical care and use pharmacists in support of this effort - Medication Reconciliation (Inter-professional rounding)

• Waiting time, often considered wasteful and stressful, can be utilized for education; Patient and Family education early to pre-discharge (GetWell Network)

• Improve patient stratification for discharge service customization (e.g. select patients with acute care conditions (e.g. broken hip, leg fracture, etc.) – Smart Beds, Segmented Patient Calls, Proactive follow-up with Fall Risk Patients

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Categorize patients by risk and use advance care planning and enlisting of external social and community support

Partner with specialty clinics to handle unique patients (cancer or cardio-vascular disease centers, mental illness or substance abuse rehabilitation centers, etc.)
Innovations in Patient Room
SJMO – Intelligent Care System

1. Patient call from bed
2. Wall Unit System
3. HILLROM Smart Bed
4. Getwell Network
5. Wrist worn device (5 vital signs)
6. Hand Hygiene Dispenser
7. VOALTE

Patient education system
Hand washing system

Patient communication system
Staff communication System
Patient bed movement monitoring
Nurse’s multi-functional phone

Wellness Index based of 5 Vital Signs
SOTERA VISENSIA
Study 5.1 – Impact of Technology

• Patient Call System
  • Did it improve patient satisfaction?
    • Not as much as they hoped – compared patient satisfaction data with call response
    • Added inter-professional rounding using pharmacists, nurse and nurse manager, minister, etc. depending on situation - showed improvement in trends, but not significant

• Smart bed
  • Early reduction in risk not sustained
  • Added process innovation
    • nurses were asked to rank order the risk of patients and proactively visit them to take them to the bathroom - shown positive impact and is being scaled to other floors

• Alerts and Escalation protocols to improve patient response
  • Early analysis showed that the responses varied across floors
    • Based on nurses assessment of call urgency (e.g. surgical more than oncology)
  • Address stress on nurses due to too many alerts
    • Engaged in some process changes such as allocation of nurses to high risk patient
Study 5.1 – Impact of Technology

• Use of Hand Hygiene Dispenser to reduce hospital acquired infections
  • Early struggles in getting this adopted and not much improvement in HAI
  • Changed processes to create internal competition
  • Adjust the time interval for going through the “gel” dispenser
  • Improved HAI


Study 5.2 - Patient Satisfaction in Hospitals (in general)

• On-going struggle as to what contributes to improvement in patient satisfaction
• Analyzed multiple ED patient data using both empirical and text mining of qualitative responses
  • Method itself is rather in-effective in measuring the true measures of satisfaction
  • Some factors are controllable and others outside the control of the hospital
• Developed quick surveys of patients in the hospital (patient experience)
  • Interesting results
  • Inter-professional rounding helped but not significant


Study 5.3 - Hospital Leadership

- **Alignment of Innovations in Patient Care and Hospital Metrics**
  - Greater integration of data from multiple hospital units and their overall impact on local as well as hospital metrics
  - Change in the hospital culture is needed – data driven, transparent and accountability


Boggs S.D, M.H. Tsai, M. Tanniru, "Will operating rooms run more efficiently when anesthesiologists get involved in management?" Forthcoming in a book titled, "You're Wrong, I'm Right: Dueling Authors Reexamine Classic Teachings in Anesthesia," edited by Corey Scher, Anna Clebone, Sanford Miller, and David Roccaforte, Springer, 2017
Study 6. - Innovations in OR - Optimization/Simulation

- Past Data, Physician Preferences, Patient Surgical Admissions, etc.
- Changes during the day due to complications – uncertainty in resource planning
- Operating Room Schedule for next day
- Operating Room Culture – Physician Centric
  Surgeon’s Reputation
  Lack of Team Orientation
  Resource Flexibility – Anesthesiologists, specialist, etc.
- Dynamic scheduling based on team (physician/nurse/anesthesiology) resource availability
- Move some surgeries to less expensive ambulatory care facilities – especially elective non-complex surgeries
- Allow physicians blocks of rooms to trade among each other
• Monitoring symptoms and advance care planning by linking severity of patient diagnosis with timing of such disease occurrences.

• Focus on patients susceptible to flu, allergies, and sports related injuries, and especially those with certain chronic conditions.
Study 7: ED Patient Flow Data

Patient Enters ED

Emergency Department

Admit time

Patient to a bed for evaluation

Physician Assignment to Patient

R1

Test to decision duration

R2

Moved to a clean bed

R3

Patients requested a bad for in-patient status

Patient discharged as an outpatient

Physician visits the patient

Tests

Patient discharged from hospital
Apart from summary views, separate graphs are provided to view other patterns of interest.

**Emergency Department Patient Flow:**

- Shows patients flow (# admits) across different categories – acuity, month, gender etc.
- User can filter the entire dashboard for a selected range of dates and hours and acuity of patient.
Dedicated views for physician performance and trends in bed assignment

Bed Assignment Delays:

- Shows various trends with respect to bed assignment process
- User can filter the entire dashboard for a selected range of dates and hours

Physician performance:

- Shows aggregated delays by physicians
- Capability to filter top ‘n’ physicians and sort them based on a chosen metric.
- A tree map with size based on delays and color based on # patients attended gives a visual classification and rating of physicians.
- User can filter the entire dashboard for a selected range of dates and hours and acuity of patient
## Time Spent at Various Locations while in ED

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>Average of LocationLengthOfStayDuration_Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ER 12 HALL</td>
<td>95.43</td>
</tr>
<tr>
<td>CT SCAN 1 - 40744</td>
<td>130.35</td>
</tr>
<tr>
<td>CT SCAN 2 - 40744</td>
<td>143.98</td>
</tr>
<tr>
<td>DIALYSIS ROOM A - 86590</td>
<td>290.35</td>
</tr>
<tr>
<td>EMERGENCY CENTER - 87000</td>
<td>182.53</td>
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<tr>
<td>EMERGENCY CENTER IN HOUSE - 47000</td>
<td>113.83</td>
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<tr>
<td>NUCLEAR MED - 86259</td>
<td>180.47</td>
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<tr>
<td>SPECIALS - 86737</td>
<td>13.43</td>
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<tr>
<td>ULTRASOUND - 86738</td>
<td>95.77</td>
</tr>
<tr>
<td>Grand Total</td>
<td>174.40</td>
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**Total**
- 1ER 12 HALL
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Patient Flow Analysis in ED

Exploratory Data Analysis Part 2

Number of Visits over Time
LocationInDateTime Value
October
November

Number of Visits by Time of Day

Number of Steps by Diagnosis

Diagnosis Value
Continuity of Care - Looking through readmission lens

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### Case studies

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- **Preventive care opportunities**
Subtraction & Task Unification

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Subtraction
(Task Unification (Subtraction form one system and add to another system))
Study 8: CHIP Model – Henry Ford Global Health

- Connect public health workers from different countries
- Educate them on basic clinical and non-clinical training
- Provide them access to mentors/experts
- Allow peers to learn from each other
Study 8: Preventive Strategies
CHIP – Community Health Innovator Program

• CHIP knowledge exchange portal to address global health issues
  • Experts, innovators, and public care workers in support of global health care
    • Web platform under development
    • Business model for social networks
  • Continue to explore the viability of such an approach in rural or urban health


Social Diagnosis

Understanding factors influencing patient performance post-discharge are in-part a reflection of the environment patients live in.
4 R Model

• **Roles** – patient’s roles and social functioning at the onset of the illness
  • Who the patient is – age, race, vocational or educational, material and parented, incremental and social
  • Assets and deficits – innate assets or deficits in terms of personality, including physical development and mental capacity
  • Prior social functioning – social background and lifestyle (life experiences, parental models, capacity for coping with stress, previous roles, performances and behaviors)

• **Reactions** – emotional reaction to the illness and not the illness per se
  • Feeling about the illness that affect a patient’s role and self-concept;
  • Patient’s stage of adjustment including shock, denial, depression or beginning integration
  • Reactivation of any prior social dysfunction or psychiatric crisis, and
  • Patient’s motivation for coping with the problem)

• **Relationships**
  • Whom the patient relates to and what family he has or does not have for reciprocal impact – impact of family dynamics

• **Resources**
  • Financial
  • Environmental – community setting, physical characteristics and emotional climate
  • Institutional – support systems and outside agencies - vocational, educational, religious, social and recreational
  • Personnel – relatives, friends, associations, organizations
### Social Characteristics of Patients

| Attribute | Description | Social Risk
|-----------|-------------|-----------------------------|
| A1        | Capable of self health management | Empowerment
| A2        | Has the knowledge or acquire it for follow-up care | Knowledge Capacity
| A3        | Has family to help support the care related responsibilities | Distribution of responsibility
| A4        | Has an opportunity to collaborate with care givers post-discharge | Inter-organizational Linkage
| A5        | Has inherent risk factors to follow treatment protocols | Factors outside the treatment protocol can complicate effectiveness

**Study 9? - Not yet started - Multi-Criteria Decision Making and Assessing a Patient’s Social Risk**

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Mohan Tanniru (tanniru@oakland.edu)
Antimicrobial resistance (AMR) in low- and middle-income countries (LMIC) is an important issue that would benefit from increased integration of health information technology. This proposed website is a part of a phased approach to help clinicians, policy makers, and program administrators choose targeted interventions based on objective data related to local contexts, and specific resistant pathogens.

- The First Phase - Specific guidelines for therapeutic action will be provided based on disease state, and pathogen information.
- Future Phases - Data available using a mobile App and link with some of the laboratory data and antibiogram-level data to the application to make smart decisions based on resistance patterns seen at hospitals. Also, this data will be refined for specific country.
Public Health in Global Context

Pathogens
- Chlamydophila sp.
- H. influenzae
- Streptococci
- Anaerobes
- Bacteroides sp.
- Chlamydia
- Enterobacteriaceae
- Enterobacteriaces
- Enterococci
- Gram-negative bacteria
- Group B Streptococci
- H. influenzae
- Legionella sp.
- Legionella sp. (e.g. atypicals)
- M. catarrhalis
- Mycoplasma sp.
- N. gonorrhoeae
- Enterobacteriaceae
- P. aeruginosa
- S. pneumoniae
- Staphylococci

Physician
- Suggest Therapy

Pelvic inflammatory disease
- Osteomyelitis
- Meningitis, community-acquired
- Intra-abdominal infection
- Severe sepsis/septic shock with MDR suspected
- Community-acquired
- Community-acquired Inpatient therapy
- Community-acquired outpatient therapy
- Sepsis
- Pneumonia
- COPD
- With risk factors for multidrug resistant bacteria* (healthcare or ventilator associated)
Summary – Continuity of care need connected health systems across care givers

Knowledge Sharing
Connecting Social and Clinical Factors in support of patient care quality over a longer time horizon

Technology Enablement

Social and Environmental Factors

- Community
- Family

Clinical Factors

- Specialist
- Physician

Patient Data

Medical/Clinical Diagnosis Data

Specialist/Physician Data

Electronic Medical Records

Physician/Discharge Care Data

- Patient Social Media Data
- Patient Family Data
- Patient Support Group Data

Health Care Policies

Prevention/Wellness

- Social Risk Factors
- Pre-Admission
- Peri-Operative/Hospital Care

Hospital governance

Discharge Planning

Collaboration among Care Providers

Post-Discharge Care

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Questions