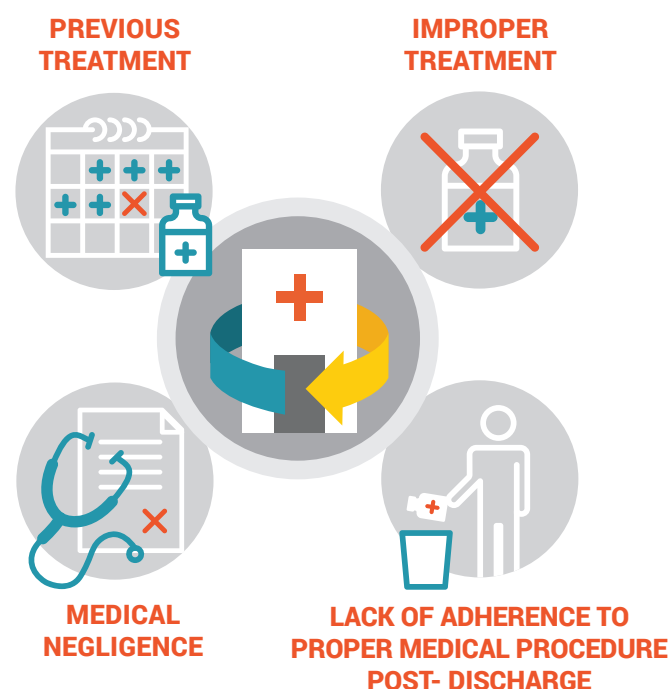


Readmission Analytics Use Case for DIWO



Why do we need Readmission Analytics?

Readmission is the hospitalization of post-treatment /discharged patients due to reasons attributing to either medical complications ee from previous treatments, improper treatments, medical negligence, or lack of adherence to proper post-discharge medical procedures. Today by estimate, about 20% of total medicare beneficiaries are readmitted to the hospital within 30 days of discharge, costing United States healthcare services over \$41 billion of public resources annually. With the growing need for medical services due to an aging population and expanding social net, these numbers are expected to rise exponentially. This is alarming! The Obama administration has addressed this issue, and identified the reduction of hospital readmission rates as a national priority, outlining clear incentives attached to this goal. The introduction of The Patient Protection and Affordable Care Act of 2010 has created new incentives to reduce readmissions using publicly reported measures. Hospitals with high readmission rates can lose up to 3% of their Medicare reimbursements by 2015, with that number expected to increase.



Studies indicate that preventable readmissions are anywhere between 5% - 79% across hospitals. An analysis of 2005 Medicare claims data by the Medicare Payment Advisory Commission (MedPAC) concluded that about three-quarters of readmissions within 30 days were potentially preventable, representing an estimated saving of \$12 billion in Medicare spending. Readmission penalties are collected from hospitals through a percentage reduction in their base Medicare inpatient claims payments, up to a cap. The ACA set the penalty cap at 1% of aggregate IPPS base payments for the first year, 2% for the second year, and 3% for each year thereafter. Hospitals are required to report data to CMS to determine hospital-wide, all-cause readmission rates for all patients (that is, not only Medicare patients). CMS began applying excess readmissions penalties to hospital payments in 2012 leading to:

1. In 2013; 2,200 hospitals were penalized an aggregate \$280 million ~ 0.3% of total Medicare base payments
2. In 2014; 2,225 hospitals were penalized an aggregate \$227 million ~ 0.2% of total Medicare base payments due to the underlying structure, about half of the hospitals in the program are always going to face a penalty, and the overall magnitude of the penalty will stay the same even as hospitals overall improve over time. As a result service providers, despite reducing their readmission rates, may end up penalized. Providers therefore need to constantly innovate and invest in systems that would help them identify gaps in the current milieu, and suggest strategies to mitigate.

*A hospital's excess readmission ratio is a measure of a hospital's readmission performance compared to the national average for the hospital's set of patients with that applicable condition. Source: CMS.gov

What is the definition of readmission?

Readmission is the hospitalization of post-treatment/discharged patient due to reasons attributing to either medical complications arising from previous treatments, improper treatments, medical negligence, or non-adherence to post-discharge medical procedures within 30 days of discharge. Penalty for

readmissions are based on the reason stated above for specific disease types. There are two types of Readmissions: Planned and Unplanned Readmission. Planned Readmissions are necessary for treatments and may not attract penalties. Unplanned Readmissions are mostly avoidable and in some cases attracting avoidable penalties from regulators. For that reason, we can also define Unplanned Readmission.

What are the elements for defining interventional strategies?

1. Intervention By:

Stakeholder(s) responsible, accountable and informed about the intervention

2. Intervention With:

Channel(s) or medium(s) through which intervention will be executed

3. Implementation Do:

Strategy or messaging that needs to be delivered as part of strategy

What are the focal points for determining interventional strategies?

1. Disease Type:** We are focusing on the following disease types

- a. Heart Failure (HF)
- b. Acute Myocardial Infarction (AMI)
- c. Pneumonia (PN)
- d. Hip/ Knee replacements
- e. Chronic Obstructive Pulmonary Disease (COPD) – Financial year 2015
- f. Coronary Artery Bypass Graft (CABG)- Financial year – 2017

2. Factors affecting 'Readmission'

- a. Premature discharge or inadequate post-discharge support
- b. Insufficient follow-up
- c. Therapeutic errors
- d. Adverse drug events and other medication related issues
- e. Failed handoffs
- f. Complications following procedures

g. Nosocomial infections, pressure ulcers, and patient physical injury(s)

3. Risks related to 'Readmission'

a. Clinical

- i. Use of high-risk medication (antibiotics, glucocorticoids, anticoagulants, narcotics, antiepileptic medications, antipsychotics, antidepressants, and hypoglycemic agents)
- ii. Polypharmacy (five or more medications)
- iii. More chronic conditions
- iv. Specific clinical conditions (e.g. advanced chronic obstructive pulmonary disease, diabetes, heart failure, stroke, cancer, weight loss, depression)

b. Non-Clinical

- i. Prior hospitalization, typically including unplanned hospitalizations within the last 6 to 12 months
- ii. Ethnicity
- iii. Low health literacy and awareness
- iv. Reduced social network indicators in terms of social-emotional support
- v. Lower socio-economic status
- vi. Adverse environmental conditions

**Data that we are using for DIWO readmission analytics. However, there are additional diseases where the hospitals will be penalized, if there are readmissions over the national average.

Who are the stakeholders ('Intervention By') in delivering interventional strategies?

Delivery of effective interventional strategy for reducing readmission (read 'Avoidable Readmission') is across various stakeholders provides medical assistance or medical care or post-discharge care or monitoring. All stakeholder(s) forms patient's support structure for intervention.

1. Immediate (Operating) Doctor
2. Specialists
3. Primary Care Physician (PCP)
4. Head Nurse
5. Registered Nurse (RN)

What are the various channels or modes ('Intervention With') for delivering interventional strategy?

There are multiple ways of reaching out to discharge patients to effectively deliver the interventional strategy. These modes can be defined in two broader sets:

1. Passive Mode (Virtual)



- a. Face-to-Face: 2-way Interacting with patient via F2F app with relevant stakeholder.
- b. Chat/Phone: 2-way Interacting with patient via chat/phone with relevant stakeholder.
- c. Drug Admission (Remote): Deliver additional medication through family remotely.
- d. Email/SMS/Mailer: 1-way (Outbound) communication to patient via email or SMS.

2. Active Mode (PhyAsical)



- a. 911: Visit by paramedics in case of emergency, including transportation to hospital.
- b. Home Visit: Physical visit of medical personal to patients home for check-up.
- c. OPD/Clinic Visit: Physical visit of patient to the assigned OPD or clinic for check-up.
- d. Drug Admission (Onsite): Deliver additional medication or drug via authorized personal.
- e. Medical Test and Report: Physical visit of patient to medical lab for testing.

- f. Alternate Medication/Therapy: Physical visit of patient to recommended alternate.
- g. Community Event: Physical visit of patient to community event or service for care.

3. Remote Monitoring



1-way accumulation of key vital stats of the patient by devices

What are standard operating procedures ('Intervention Be') for delivering interventional strategies?

This section covers key operating procedures need to be followed for effective interventional strategy by assigned stakeholder to ensure care delivery:

1. Clinical Interventions

- a. Invasive Interventions
- b. Non-Invasive Interventions
- c. Cognitive Interventions

2. Health Education

3. STS Interventions

4. Tele Monitoring:

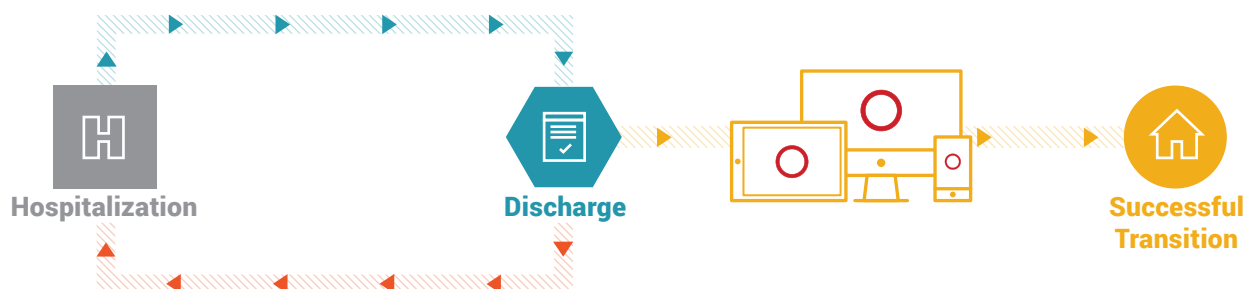
5. Medication Reconciliation

6. Discharge Planning and Follow-up Apa

7. Bridging Interventions

What are the recommended interventional strategies?

Holistic interventional strategies are the actions (SOPs) to be followed based on intervention type, patient type and condition (disease) type.



1. Intervention Type

- a. Pre-Discharge Interventions
- b. Post-Discharge Interventions

2. Patient Type vs Condition Type

Patient vs. Condition	Lifestyle Condition	Non-Chronic Condition	Chronic Condition	Life Threatening Condition
Hyper Sensitive	Cautious	Critical	Super Critical	Super Critical
Highly Sensitive	Concerned	Cautious	Critical	Super Critical
Low/Mid Sensitive	Negate	Concerned	Cautious	Critical

How does DIWO work in the background to provide insights on readmission scores, risk profiling and intervention strategies?

DIWO works with the historical data stored in internal and external source systems for typical healthcare service providers (EHR, Admission Systems, Discharge Systems, Billing Systems, CMS, CCA, Geneva etc.). These systems are integrated with DIWO to provide the data needed to perform analytics:

1. Macro Analysis:

- a. Descriptive Analytics:** Slicing and dicing of historical data into relevant segmentations to understand the overall readmission rates across these segments, macro-level benchmarking, determine historical performance indicators, broad reasons for high/low benchmarks and strategies to be defined.
- b. Near-real Time Analysis:** Ingesting incremental daily/hourly data points to understand the current landscape of readmission across segments, current performance indicators to visualize and deep dive into the micro-level segments (patient level data).
- c. Financial Impact and Penalty Forecasting:** Estimating the penalty amount by predicting the readmission rate for the future periods.

2. Future Event Analysis (Predictive Analytics):

- a. Risk Assessment:** Computation of patient-level the risk score and patient's risk profile at the time of admission based on the historical and cluster level

insights generated by an advanced algorithm running on historical data for computation.

b. Readmission Rate Probability: Computation of patient-level probability of getting readmitted within 30 days post discharge triggered at the time of discharge initiation (post triage). The probabilistic score is an absolute percentage numeric wherein the higher the value, the higher the chance of readmission within acceptable statistical accuracy levels.

c. Readmission Timeline: Computation of the probabilistic timelines within which the target patient is expected to be readmitted post discharge within D+30 days to define the suitable window within which intervention strategies need to be executed.

d. Intervention Timelines: Computation of the probabilistic timelines within which the target intervention strategies need to be executed on the target patient for them to be most potent and effective.

3. Recommendation (Insight Generation):

- a. Target Population:** Given the limited operational resources to be leveraged for delivering cost-intensive interventional strategies, DIWO will identify the target patients on whom service provider can maximize their impact to reduce their readmission risks.
- b. Target Intervention Strategy:** Post identification of target patients for interventional strategies, DIWO will recommend the actions to be performed based on the risk-profile, disease type and operational policies, if any.
- c. Impact Assessment of Intervention Strategy:** DIWO to assess the overall impact of interventions applied on target population and the value delivered to the business.



What is the technical architecture of DIWO for Readmission Use Case?

DIWO® runs on a dedicated cluster of commodity hardware with redundant storage and computing nodes to provide fault-tolerance and resilience. DIWO® requires four logical clusters one each for AKKA, Apache Cassandra, Apache Spark, and Apache Kafka. All these clusters share the same physical cluster of anywhere from 8-12 nodes, depending on the complexity of use cases. DIWO® is fine-tuned to run on a standard configuration in a dedicated environment with the on premise appliance philosophy but can operate in a cloud environment, if so desired.

Recommended Changes:

1. Source Systems: HMS (Hospital Management System); Patient Records Database/Admission Record System; Hospital Billing System; DRG Systems; CMS External Data Source; CCA Risk Profile External Database; Social Data (*in future)
2. Infrastructure Layer: <No change recommended, please review internally>
3. Virtual Resource Layer: Cassandra, HBase, S3/DB2
4. Application Layer: Need to add Statistical Tool (R and SparkML)
5. Connect: Kafka, Play
6. Visualization: D3.js, Angular.js, Play Server

What is the impact of DIWO on Readmission Analytics?

With built-in capabilities to unearth the existing trends and patterns in readmission as well as predicting the readmission scenarios; DIWO is a potent solution to help achieve readmission goals. DIWO can potentially address your current readmission challenges by working on the patient's level with remarkable results***:

- **One-third of patients interviewed reported that no follow-up arrangements had been made after hospital discharge. Two-thirds of those readmitted had no follow-up.**
- **Only 25 percent of primary-care physicians were involved in discussions with physicians about patients' discharge plans.**
- **None of the primary-care physicians of readmitted patients had been notified of patients' discharge. Forty-five percent of patients left their physician office visit not understanding what their physician told them.**
- **19% of patients reported receiving conflicting info from doctors.**
- **Patients participated in medical decisions only 8% of the time.**
- **Reducing hospital readmissions among chronic heart-failure patients would result in a 1% decrease in overall operating revenues for the hospital, but would represent a 20% reduction in inpatient costs for insurers.**

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