UTILIZING REAL WORLD BIG DATA AND VISUAL ANALYTICS TO EXAMINE THE PATIENT JOURNEY

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Outline

- What is the Patient Journey?
- Why is the Patient Journey important for Pharma?
- What are Treatment/Clinical Pathways?
- Real World Big Data (RWBD)
- Examples of RWBD
- Options to visualize Treatment Pathways
- Sankey diagrams
- Our Experience
- Conclusions
What is the Patient Journey?

A formal term for the sequence of care events which a patient follows from the point of entry into the system triggered by illness until the patient is discharged from hospital to his or her home, care home, hospice or due to death.

Segen's Medical Dictionary
Why is the Patient Journey important for Pharma?

- Gaining insight into how prescription drugs are used by HCPs and patients in the real world over long periods of time has become a necessity in drug development, where this information is used for:
  - Cost of care analysis
  - Healthcare resource utilization analysis
  - Comparison between clinical practice guidelines and real world drug utilization patterns
  - Identification of gaps of care
  - Prescription patterns by physician specialty
  - Patterns of care analysis, facility/service type
  - Outcomes of care: patient-level CER
  - Find hard to find patients using real time data
What are Treatment/Clinical Pathways?

Clinical pathways, also known as care pathways, critical pathways, integrated care pathways, or care maps, are one of the main tools used to manage the quality in healthcare concerning the standardization of care processes. It has been shown that their implementation reduces the variability in clinical practice and improves outcomes. Clinical pathways promote organized and efficient patient care based on evidence based practice. Clinical pathways optimize outcomes in the acute care and home care settings.

The source for Patient Journey analytics: Real World Big Data
Examples of RWBD

- Claims (from payers or data vendors): Truven (MarketScan), IMS (PharMetrics), United Health Group (Optum), Wellpoint, Aetna, Humana, CMS
- EMR/EHR (from Healthcare providers or EMR vendors):
  - Nation-wide: VA, DoD, GE Centricity, Allscripts, Cerner, Humedica, Flatiron
  - Regional: Kaiser, Regenstrief, Partners, Mayo, Intermountain, Geisinger
  - Academic: Harvard, Univ of Utah, Vanderbilt, Cincinnati Children's Hospital
- Surveys and registries: NCHS (NHANES, NHIS, NAMCS, NHAMCS, NSAS, NHDS, NNHS, NNAS, etc.), SEER registries, MEPS, ACC registries
- PBM/Pharmacy Databases: Medco, Wallgreens, CVS, Walmart
- Lab databases: Quest, Labcorp
- PHRs: patient portals, MS HealthVault, Indivo X, CMS PHR Pilots
- Patient forums/social media: Patientslikeme, inspire.com, smartpatients.com
- Monitoring/wearables: medical device data, Apple ResearchKit
- Panomic data (genome, proteome, metabolome, immunome, microbiome, exposome) from patients, integrated with EMR/EHR
Multiple options to visualize Treatment Pathways
Sankey Diagrams

Some definitions for Sankey diagrams:

“Sankey diagrams are a specific type of flow diagram, in which the width of the arrows is shown proportionally to the flow quantity. They are typically used to visualize energy or material transfers between processes.”

(source: Wikipedia, article ‘Sankey diagram)

“A Sankey diagram is a directional flow chart where the width of the streams is proportional to the quantity of flow, and where the flows can be combined, split and traced through a series of events or stages.”

(source: CHEMICAL ENGINEERING Blog)

“Sankey Diagrams are attention grabbing flowcharts that help in quick visualisation of the distribution and losses of material and energy in a process. The width of the lines used in drawing the flowchart is proportional to the quantum of material or energy.”

(source: http://www.sankeydiagrams.com)
Examples of Sankey Diagrams in other domains
Our Experience – Methods (Part 1)

To address our internal demand for a visual analytics tool that would help us understand the Patient Journey in general, and Treatment Pathways in particular, we developed an interactive visual analytics solution with the following capabilities:

- *Ingests patient level data from RWBD sources*
- *Generate disease cohorts based on standardized phenotype definitions*
- *Extract relevant clinical event patterns (diagnoses, prescriptions, procedures, providers)*
- *Reconstruct treatment pathways using business rules from domain experts*
- *Visualize sequential lines of therapy patterns (population level)*
- *Visualize individual patient timelines*
- *Display patient characteristics, cost and HRU patterns*
Our Experience – Methods (Part 2)

■ Data sources used so far:
  – Claims (Marketscan
  – Proprietary disease registries

■ Disease areas used to date:
  – Hem/Onc: AML, MM
  – I&I: Crohn’s, Psoriasis

■ Technologies used:
  – Big Data/Cloud: Hadoop/AWS
  – Analytics: R, Rstudio, Shiny, D3.js
  – Visualization algorithms: Sankeys, Individual Patient Timelines
Example Treatment Pathways from Claims data

many patients started w/ aminosalicylate or immunosuppressant, suggesting these were mild cases.

most patients started w/ corticosteroid, suggesting they got their 1st diagnosis during a flare.
Example Individual Patient Timeline

This is a severe case: starting with a flare and followed by another flare 2 yrs later. Should've this patient been managed more aggressively after the 1st flare?
Conclusions

- Our solution has proven effective in helping to understand the patterns of care for a disease-specific patient population, and in gaining insight into how prescription drugs are used in real world patients.

- This opens the door to a broad range of uses of this information across multiple functions in the drug development industry, including Health Economics and Outcomes Research, Epidemiology and Market Access, among others.

- Future directions include expanding the data sources to incorporate EHR data as well as EHR/Claims integrated data that would bring a richer set of treatment-related clinical data elements that would help overcome some of the limitations of using claim databases alone, including limited inpatient drug data and limited granularity in the drug strength, frequency and total daily dose, among others.