CBA Workshop Series -3

Drug Safety (Pharmacovigilance) and Big Data

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Drug Safety

- Drug Safety is about Adverse Drug Reaction or ADR
- ADR is any unintended and harmful drug response
- Complete Benefit/ Risk Evaluation over the life cycle of the drug to enhance the decision-making process to maximize treatment effectively, reduce risk and prevent harm
- Pharmacovigilance (PV or PhV) is science and activities relating to the collection, detection, assessment, monitoring, and prevention of drug adverse effects

Drug Safety – Pre-market

- Average new drug development cost and time according to CSDD:
  - **$2.5 billion**
  - **12 years to develop**
- A general failure rate > **90%**
- Safety is a big reason for failure of many investigational drugs in late-stage clinical development.

Drug Safety – Post-market

- Limitations of pre-market clinical trials because of:
  - Limited population – specific age and gender
  - Limited indications – only the specific disease studied
  - Short duration – only a few weeks
- Post-approval (Phase IV) studies to determine specific safety issues
- Over 100,000 deaths each year as a result of taking medications as prescribed in US
- To keep drug on market, post-market monitoring and surveillance are required by regulatory agencies

Safety Signal Detection

- To identify:
  - New, previously unknown, adverse event
  - New drug interaction
  - An observed change in quantity, severity or the affected populations of a known adverse event
- From data sources – big data
  - Spontaneous databases such as FARES and Vigibase. Each database has over 10 million safety reports and grows by over 1 million per year.
  - Electronic healthcare records – millions
  - Medical literature – millions
  - Social Media – plenty of embedded medical information
  - Others

Technologies

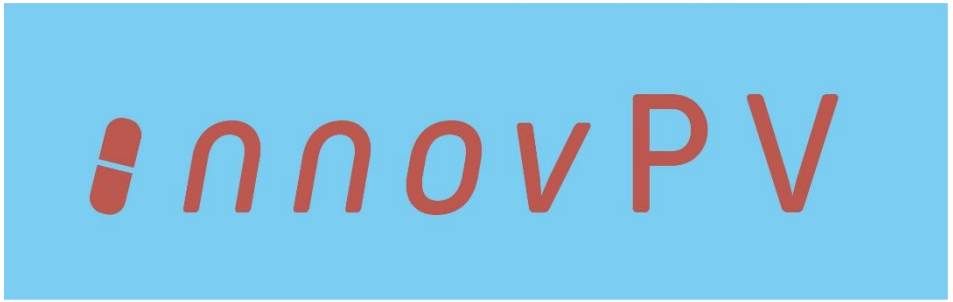
- Data Mining & Analytics – using mathematics tools to identify safety signals
- Data Visualization – facilitate safety signal detections
- Nature Language Processing (NLP) – process unstructured data such as medical articles, treatment narratives, and documents to identify drug and ADR causal relationship
- Machine Learning
- Artificial Intelligence (AI)

Technologies – cont'd

- **Cloud Technology** facilitates collaboration – integrated system accessible to all parties, healthcare providers, physicians, users, researchers to store and process registered drug and potential ADRs.
- **Big Data** to protect and assimilate huge amounts of information – big data becomes the powerful tool to swiftly manage, classify, and profile ADRs for pharmaceutical companies and regulatory agencies to analyze; end-to-end assimilation of information and keeping data integrity and security.
- **Data Mining and Analytics** to mine safety insights – Mining the data from the Cloud and big data set to gain insight into drug safety about causal relationships between drugs and adverse or beneficial events.
- **Machine Learning** to automate signal detection – Automating the safety signal detection with intelligence improves accuracy of medical reporting and decision making and enables more proactive drug safety regulation.
- **Artificial Intelligence (AI)** – Enables assimilating large amounts of Cloud based big data set; identifying and mapping safety patterns; correlating drug class, molecular entity, and genetic profile to disease occurrences to effectively predict ADRs.

Benefits

- Early safety information detection saves money and time for drug development.
- Early risk identification improves risk management plan. Regulators evaluate pharmacovigilance plans about the monitoring systems or analytical processes for post-market drugs.
- Drug repositioning or repurposing – Discovering drugs, drug targets and ADR relationships by using Machine Learning, AI and data mining technologies to understand the molecular mechanisms underlying ADRs for better development and repurposing of drugs.



http://pvaicloud.com

- A user friendly innovative drug safety analytic tool
- Cloud based system
- Integrated with spontaneous data sources such as FDA FAERS, literature, and customized data set
- Data mining and analytics capability to detect drug safety signals
- End-to-end safety signal activity management from detecting, validating, confirming, analyzing, and managing
- Capability to facilitate drug Benefit/Risk analysis

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- Using statistical algorithms to data mining safety signals

Drug Safety Profile | Signal Analysis | Heat Map | Time Series | Literature | Topic Management | Logout

Signal Analysis For:Predefined: Drug/Event for All Time

Select New Dataset

Drug 1: axitinib
Drug 2:

Begin Date: 2004-01-01
End Date: 2017-06-30

Show 50 entries | Export | Showing 1 to 50 of 1,576 entries | Previous 1 2 3 4 5 ... 32 Next

Tracking	Drug	Adverse Event	N	EBGM	EBGM (05,95)	P-Value	IC	IC (05,95)	P-Value	PRR	PRR (05,95)	P-Value	ROR	ROR (05,95)	P-Value
Track	AXITINIB	Yellow skin	6		0.88 (0.31,2.07)	0.56		4.52 (1.69,12.06)	0.5		1.31 (0.33,5.23)	0.35		1.31 (0.33,5.24)	0.35
Track	AXITINIB	Xerosis	1		0.94 (0.26,2.66)	0.49		1 (0.88,1.14)	0.39		3.93 (0.55,27.96)	0.09		3.93 (0.55,27.98)	0.09
Track	AXITINIB	Wrong drug administered	1		0.16 (0.02,0.71)	0.99		2.51 (0.88,7.16)	0.95		0.21 (0.03,1.47)	0.94		0.21 (0.03,1.47)	0.94
Track	AXITINIB	Wrist fracture	2		0.22 (0.03,0.97)	0.96		0.81 (0.28,2.3)	0.91		0.28 (0.04,2.01)	0.9		0.28 (0.04,2.01)	0.9
Track	AXITINIB	Wound secretion	2		0.61 (0.17,1.72)	0.74		1.13 (0.33,3.9)	0.7		0.75 (0.11,5.3)	0.62		0.75 (0.1,5.3)	0.62
Track	AXITINIB	Wound infection	4		0.78 (0.21,2.26)	0.59		2.26 (1.32,3.87)	0.67		0.87 (0.22,3.47)	0.58		0.87 (0.22,3.47)	0.58
Track	AXITINIB	Wound haemorrhage	1		0.15 (0.01,0.81)	0.98		0.27 (0.06,1.32)	0.63		1 (0.14,7.09)	0.5		1 (0.14,7.09)	0.5

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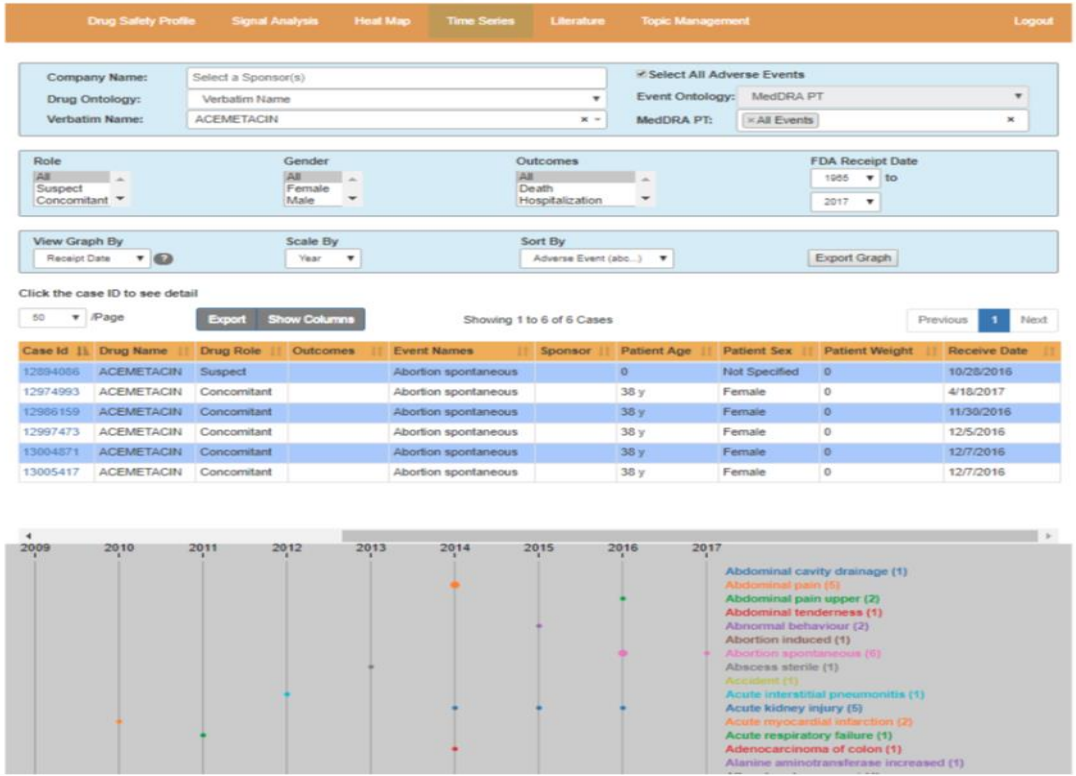
- Identify patterns and trends to facilitate signal detection



Questions?