

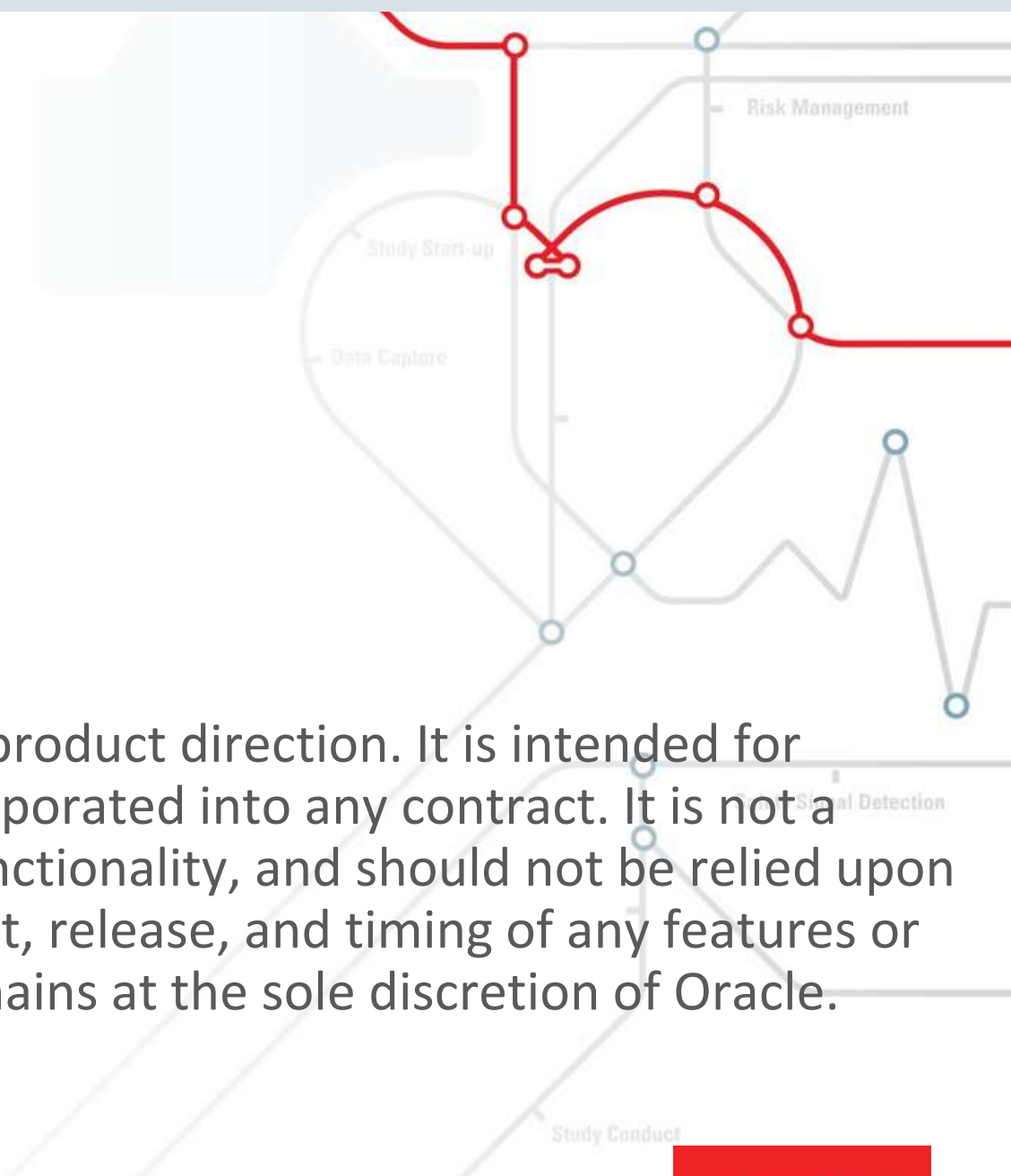
Using Upcoming AI Technology For Actionable Insights

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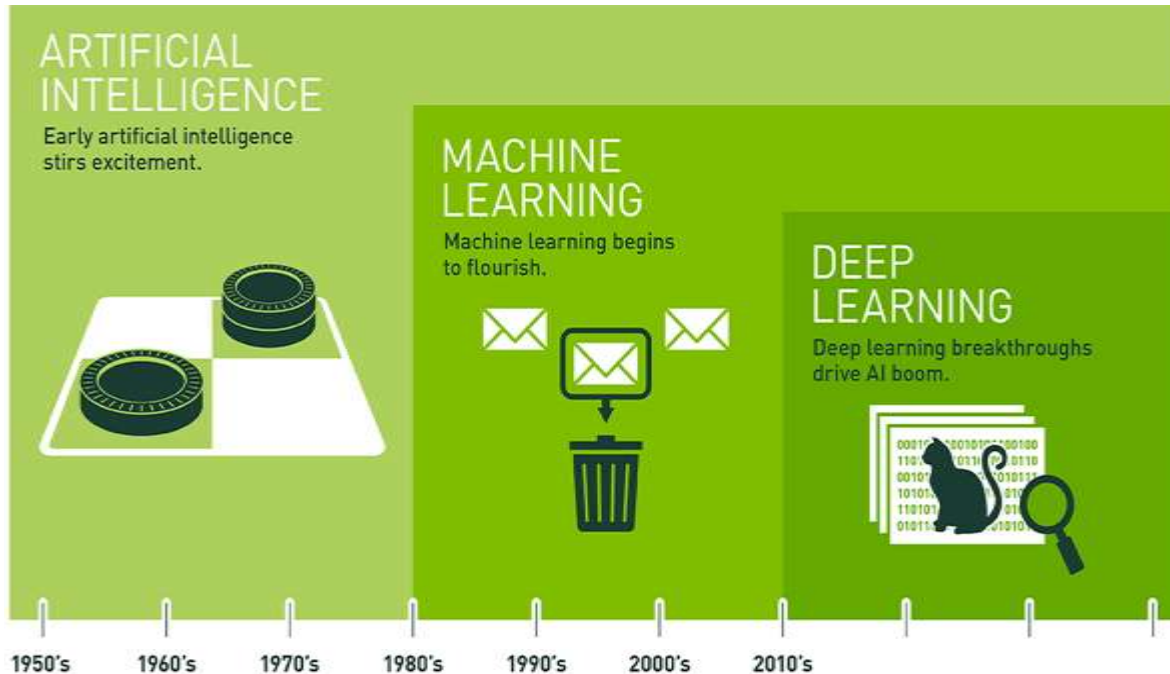




Safe Harbor Statement

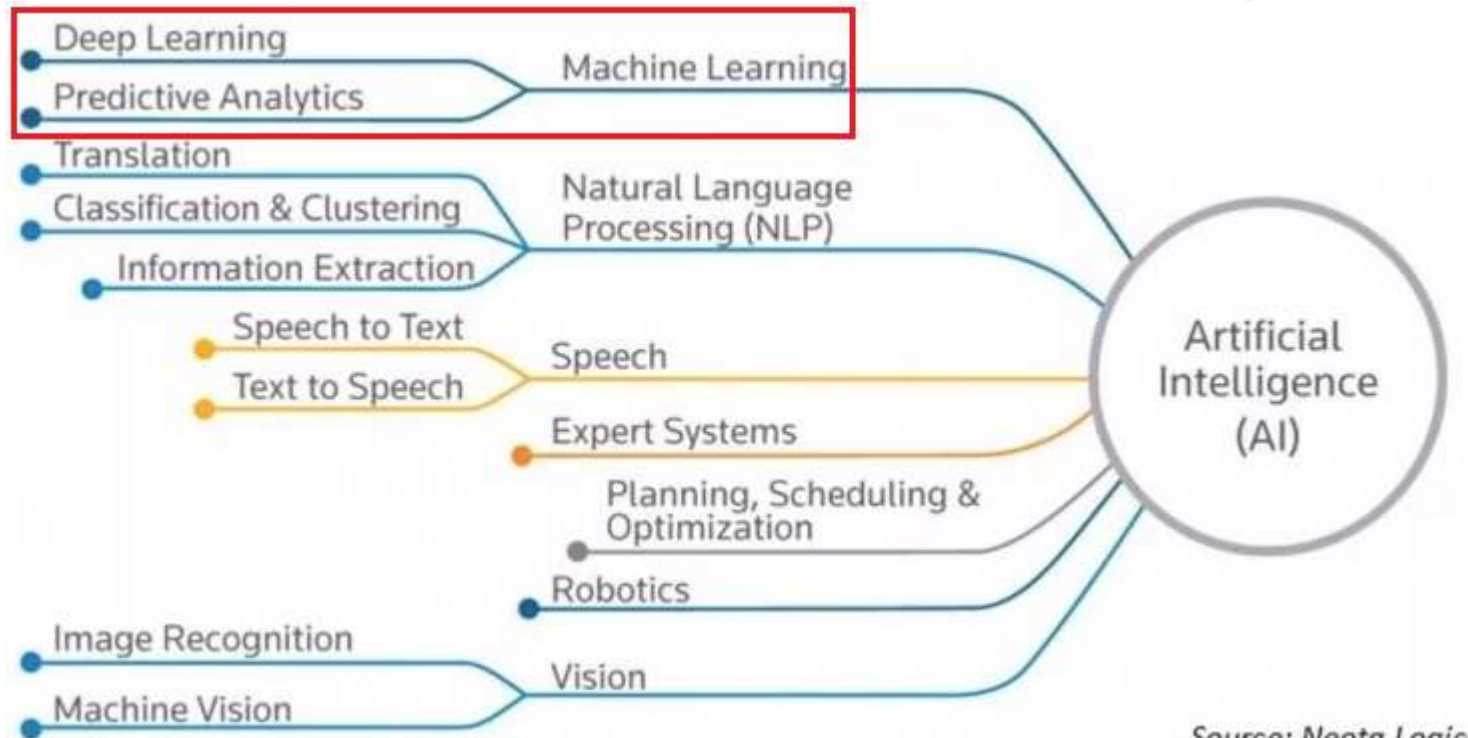
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Basics: Automation vs. AI vs. ML vs. DL



- **Automation:** rule-based algorithms, aka configurations or accelerators, that can be deployed to assist with tasks
- **Artificial Intelligence:** computer systems able to perform tasks that normally require human intelligence
- **Machine learning:** subset of AI having the ability to automatically learn and improve from experience without being explicitly programmed.
- **Deep Learning:** subfield of machine learning concerned with algorithms called artificial neural networks.

AI Overview



Transformative Ages

- 1st Industrial Revolution brought in mechanization powered by water and steam
- 3rd Industrial Revolution introduced robotic automation powered by computing networks

- 2nd Industrial Revolution saw the advent of the assembly line powered by gas and electricity
- 4th Industrial Revolution is smart and connected assets powered by machine learning and artificial intelligence

Big Data in Other Industries

Retail/Consumer

- Supply chain trending and analysis
- Behavior based campaigns

Financial

- Fraud detection, security analysis
- Abnormal trading patterns

Digital Media

- Ad targeting, forecasting and optimization
- Abuse and click-fraud detection

Healthcare

- Trial data analysis
- Drug discovery and development selection

Telecommunication

- Customer churn prevention
- Call detail record (CDR) analysis

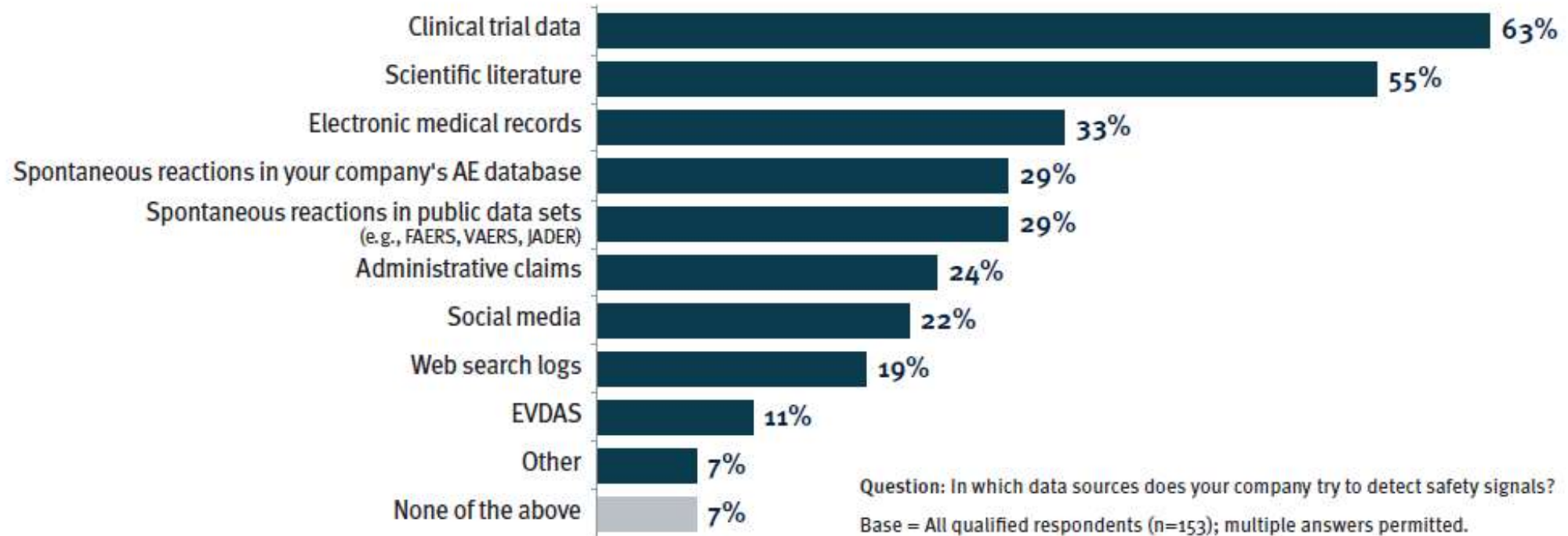
Ecommerce

- Cross-channel and predictive analytics
- Right offer at right time

Big Data in Life Sciences

Detecting Safety Signals – Data Sources

Respondents are most likely to try to detect safety signals in clinical trial data and scientific literature, followed at a distance by electronic medical records, spontaneous reactions in the company's AE database, and spontaneous reactions in public data sets.



<https://go.oracle.com/LP=67881?elqCampaignId=144621>

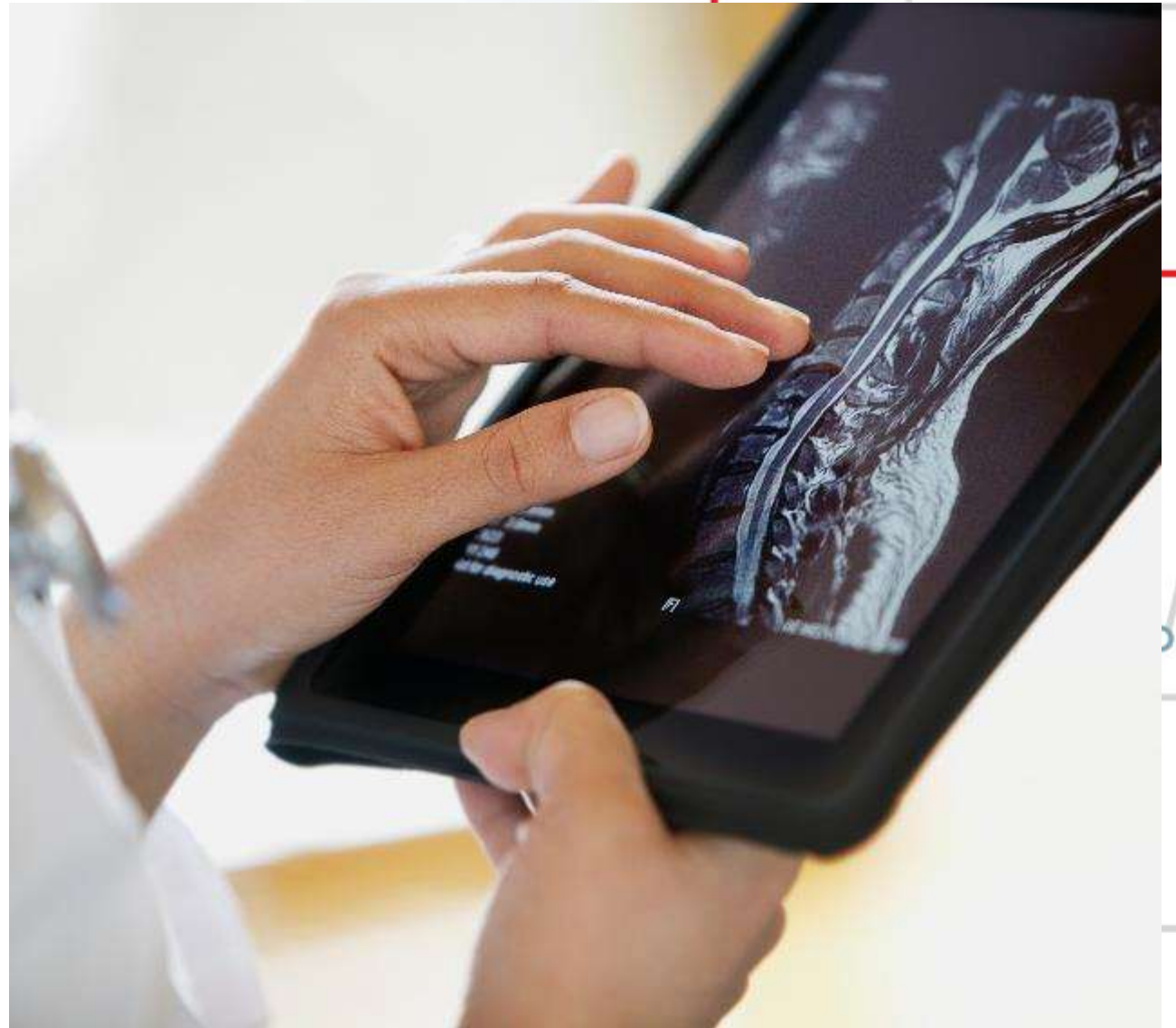
Recurrent Neural Networks (RNN) And Algorithmic Detection in Healthcare

Using aspects of AI to diagnose as well as an HCP

Human or AI Physician?

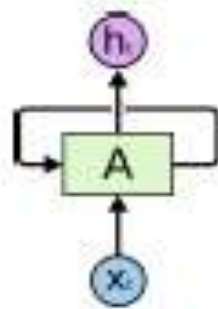
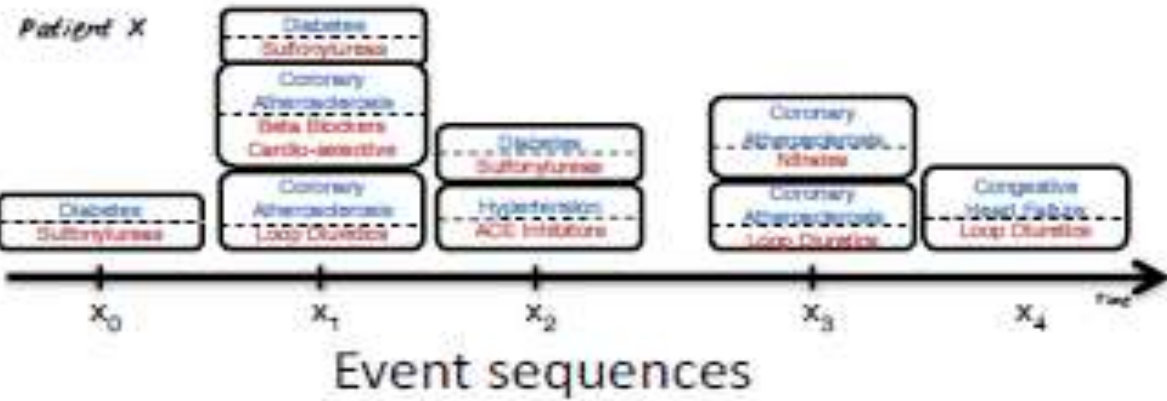
Doctor AI is a automatic diagnosis machine that predicts medical codes that occur in the next visit, while also predicting the time duration until the next visit.

<https://github.com/mp2893/doctorai>

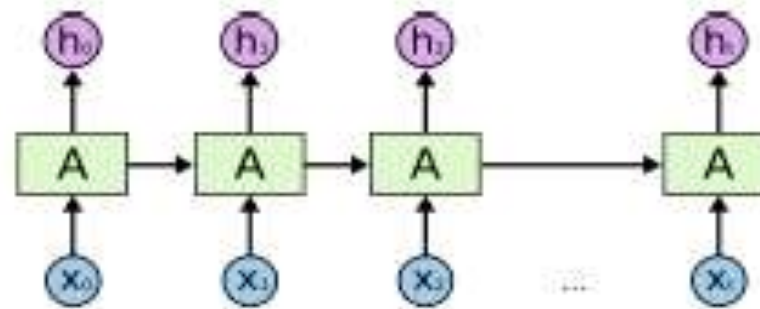


Study Conduct

Doctor AI Model

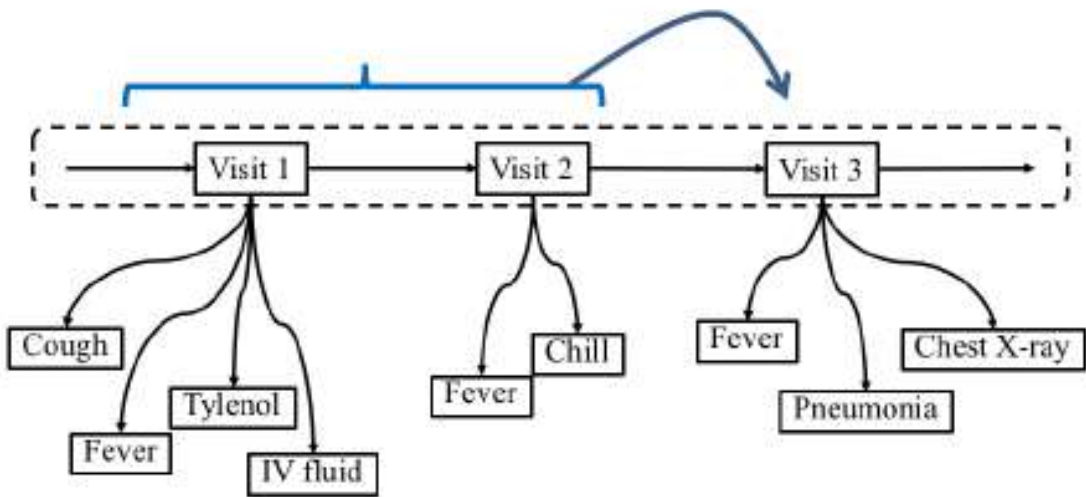


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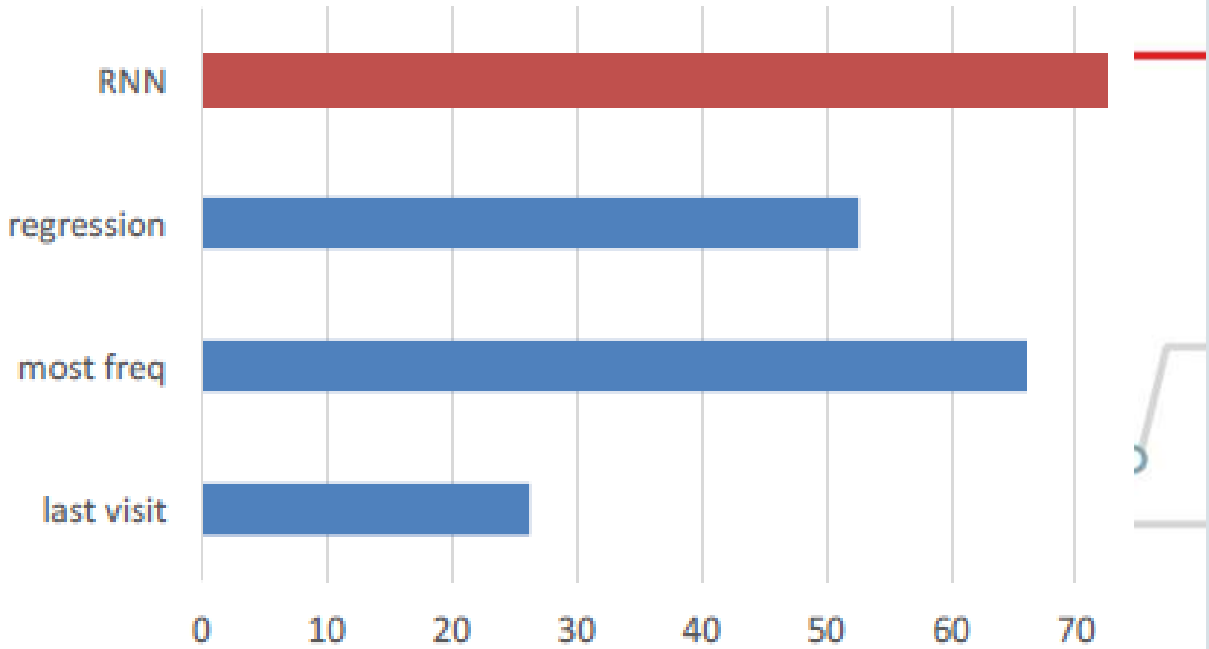
RNN model

Doctor AI Approach and Accuracy



top- k recall = $\frac{\text{\# of true positives in the top } k \text{ predictions}}{\text{\# of true positives}}$

Disease Progression Modeling



Predicting diagnoses in next visit

Deploying AI in Life Sciences

Challenges

- Psychological – will patients “trust” a machine based diagnosis
- Black box architecture – do you understand the programming and the limitations
- Bias – machine awaits instructions and data given by us and our focus/knowledge basis can influence

Opportunities

- Japanese researchers show AI can detect bowel cancer in **less than a second** – News story 30 Oct 2017
 - 94% Accuracy Rate
 - 30K images used for machine learning
 - “AI enables real-time optical biopsy of colorectal polyps during colonoscopy, regardless of the endoscopists' skill”

<http://www.zdnet.com/article/japanese-researchers-say-ai-can-detect-bowel-cancer-in-less-than-a-second/>

Case Study: Use of Bots

Using Social Listening Algorithms Towards Life Sciences Insight

Bots In Healthcare and Life Sciences



1. **Diagnosis assistance** — ask questions about their health. The chatbot then finds resources based on keywords from the user.
2. **Treatment reminders (adherence)** — the chatbots can offer to remind users to take their medications or refill their prescriptions
3. **Appointment scheduling** — Chatbots can link directly to portals to aid in scheduling doctors' appointments.
4. **Customized education** — Chatbots can also help train and educate users on a variety of topics.

NLP-Based Pharma Bots Currently Deployed

- Launched in 2016, it is the first Chatbot for Physicians in Italy and across MSD
- Uses Facebook messenger
- Uses NLP and requires registration
- Immuno-Oncology focused for now
- Future plans to integrate with Siri, and other voice recognition systems

<http://www.impossibleminds.com/portfolio-item/msd/>

MSD launches MSD Salute BOT



Online Manipulation: Bots behaving badly

Example – SNS Stream analysis

- Twitter streams can often be manipulated to achieve some goal
 - Social and viral marketing (or alternative fact based news)
 - True view on trends can be polluted by these streams
 - How can we eliminate such *noise*?



Data Set

- Data acquisition period: 2016-Feb (1 week)
- Number of topics: 675
- Number of messages: 2.6 million
- Number of accounts: 788,360

- # RT Bots: 3,092
- # RT Beneficiaries: 5
- # Removed messages: 551,177

➔ Significant changes in important accounts and trends

Information on Bots

Privacy • HIPPA mandates to keep patient health conversations private	Compliance • Use social media strategies to plan out associated risks	Adverse Events • Will require human assistance to interact with complex inquiries
Cost • Depends on complexity of programming	Integration • Relate well with marketing and outreach initiatives	Sarcasm and Tone • Will not be able to distinguish idioms or hidden meanings

Oracle Intelligent Bots AI Powered Chatbots

The Oracle Intelligent Bots platform helps customers engage with their customers and employees through common instant messaging and chat clients, like Facebook Messenger and WeChat, or by adding conversational features to their mobile apps. Intelligent Bots is a feature of Oracle Mobile Cloud.

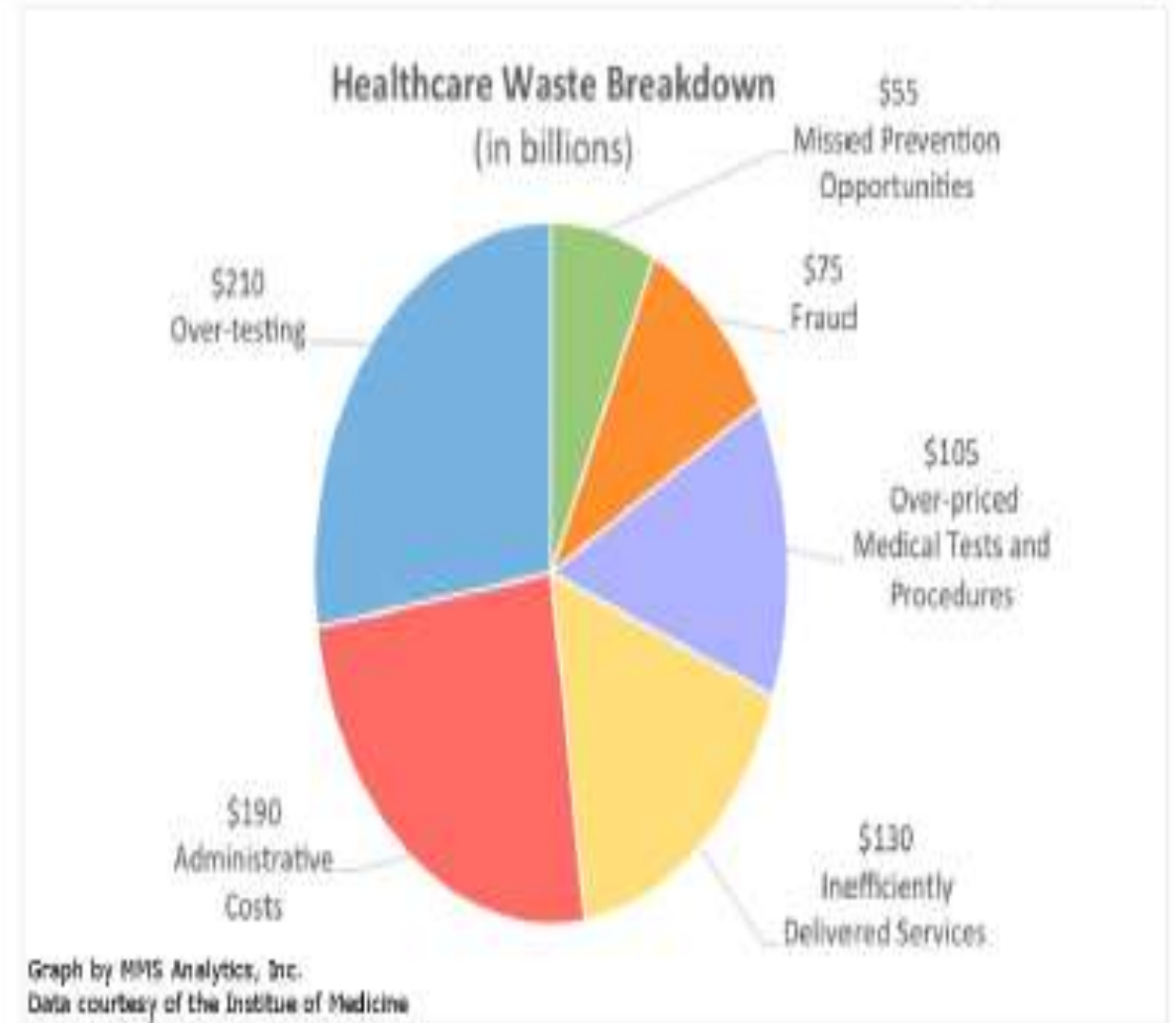
<https://youtu.be/D6yUTrJc2W4>

AI/ML/DL Case Studies Applied to Life Sciences

Challenges and Opportunities

\$765 Billion

Preventable Wastage of Monies



Challenges For Adoption Into Life Sciences

- Multiple domains in Life Science industry, so data is in silos and bottlenecked
- Tapping into unstructured and structured datasets ideally requires a single source of truth to exist company-wide
- “Psychological embrace” – doubt that any AI/ML/DL can perform to the same accuracy and specificity as human who has learned the role via experience

- Gaining insight from dynamic lexical resources, such as HCP and Consumers
- As ML validity expands, when to re-test system in an audit
- Structured versus Unstructured data and degree of subjective outlier association

Opportunities For Transformative Change

- Embrace new methodologies such as Chatbots and deploy actionable insights
- Risk mitigation and collaboration with regulatory agencies
- Plateau will be achieved in ML datasets but will undergo period of high risk and uncertainty

- Getting started with advanced analytics is as much about changing mind-sets and culture as it is about acquiring tools and skills, according to Gartner, Inc.
- Failure to make these changes can be fatal to success.
- Gartner predicts that [as of 2017], 40 percent of big data projects will go beyond piloting and experimentation.

Focus On Drug Safety & Pharmacovigilance

Predictions for Pharmacovigilance 3.0

(PV 1.0 = push data; PV 2.0 = pull data; PV 3.0 = intuitive data)

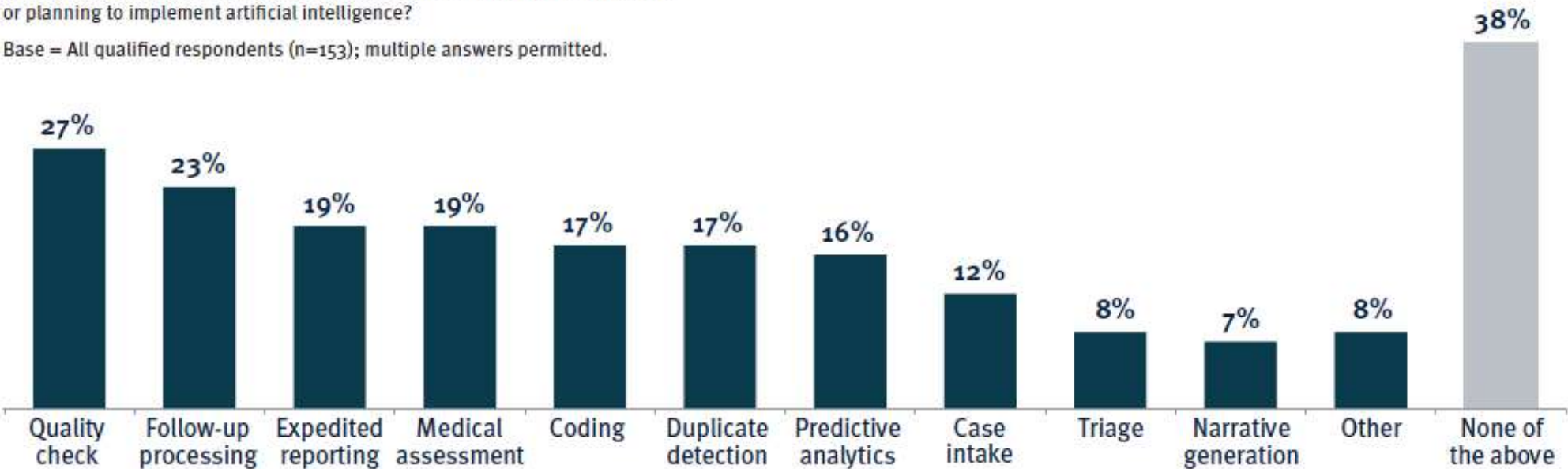
Role of Artificial Intelligence in PV

Implementing Artificial Intelligence In AE Case Processing

The majority of respondents (62%) are actively implementing, or planning to implement, artificial intelligence in AE case processing. The areas in which they are most likely to do so include quality check, follow-up processing, expedited reporting and medical assessment.

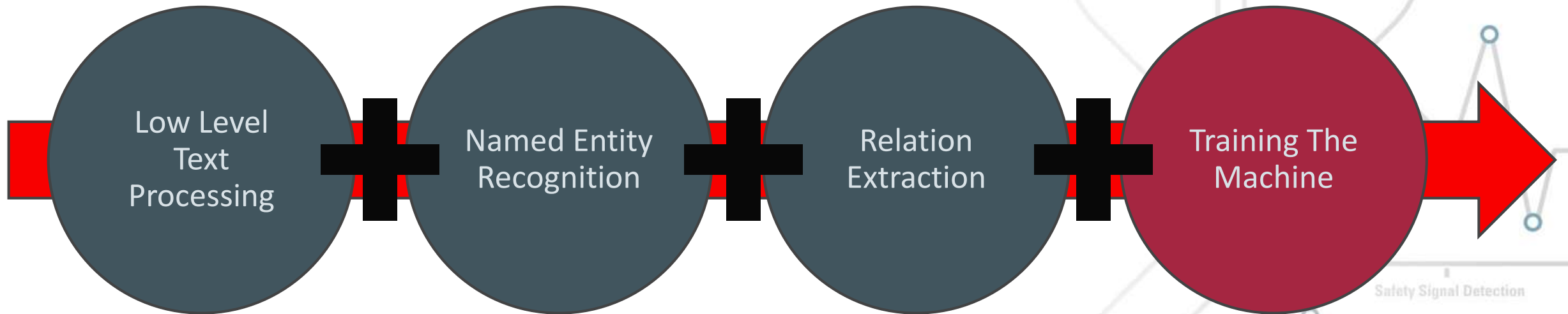
Question: In which areas of AE case processing are you actively implementing or planning to implement artificial intelligence?

Base = All qualified respondents (n=153); multiple answers permitted.

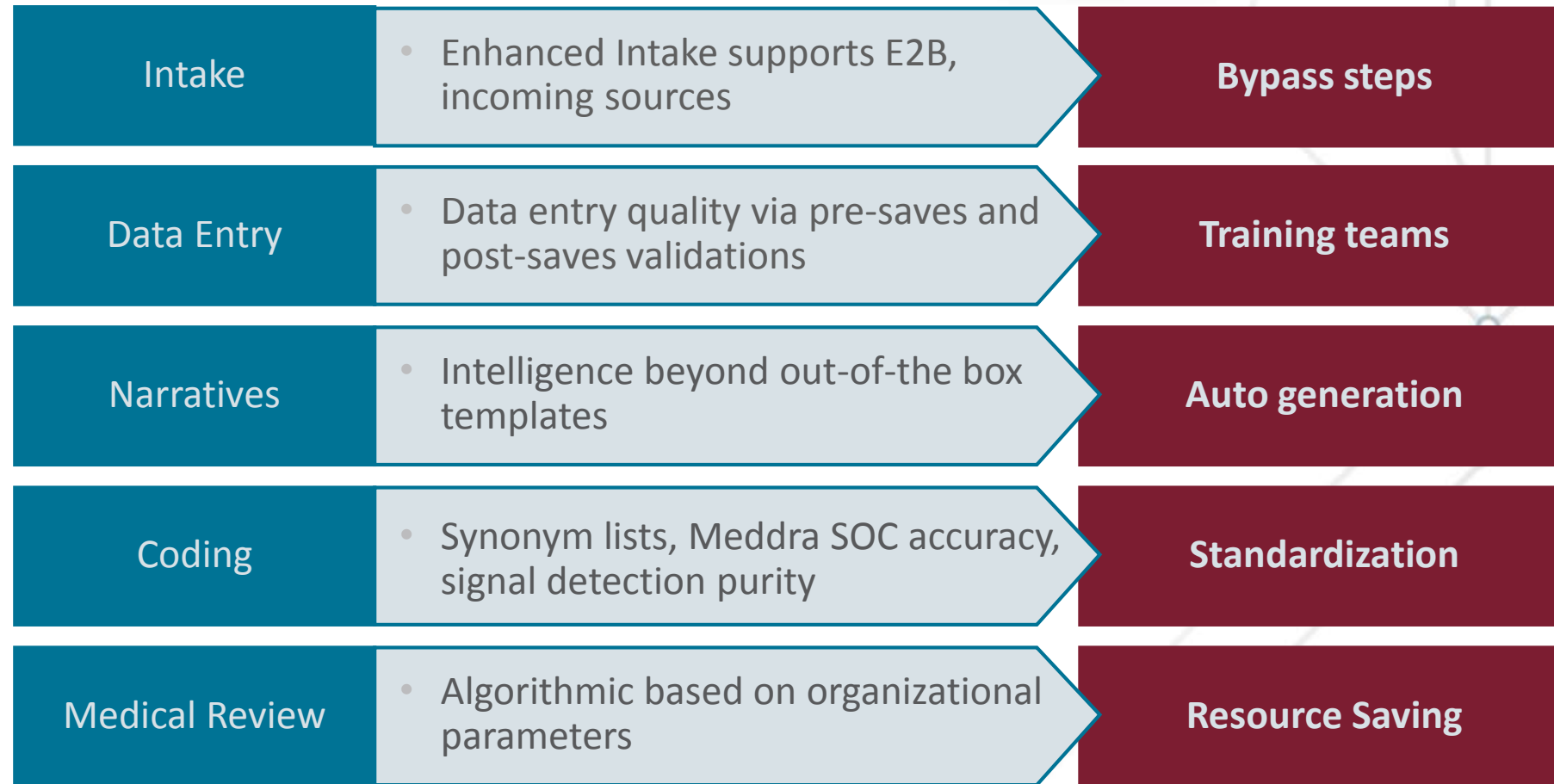


<https://go.oracle.com/LP=67881?elqCampaignId=144621>

AI: NLP Model Still Requires Assistance



Automations Provide Immediate Efficiency Gains



Type of data	Stage of use of data mining	Data mining method or tool	Data mining purpose
Medical literature	Developmental	Linguamatics I2E natural language processing; using chemical structure information from the medical literature	Study clinical safety
		G-VISR (Georgetown Vaccine Information and Safety Resource) tool	Collect molecular and adverse event information
Medical device documents	Developmental	SARF semantic text mining	• Search within any number of repositories • Screen for massive lists of items within repositories
Clinical study data in drug applications	Routine	Empirica Study™ creation of a wide set of automatically generated analytical outputs and tailor-made, reusable tables and graphs	Save reviewers from having to create the tables and graphs
Social media	Developmental	MedWatcher Social; uses standard product and adverse event dictionaries	Detect adverse events related to medical products
Tobacco documents	Developmental	Topic modeling methods	Characterize documents and estimate topics covered by the documents
Questions received at the CFSAN Call Center	Developmental	SAS™ data step programming and SAS™ text mining node	Categorize and group the predominant types of questions
	Routine	SAS Enterprise Miner™	Maintain standardized data fields

Automations Tools Being Used



Developmental

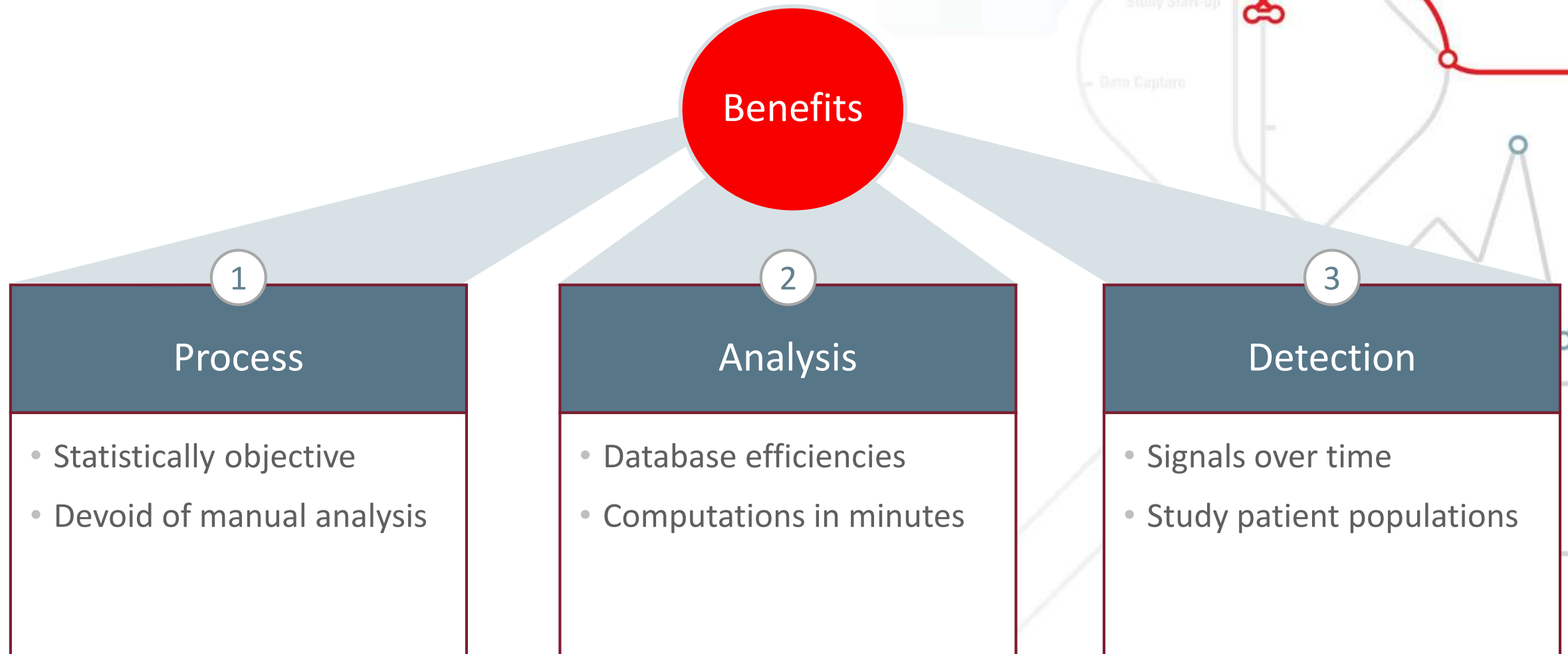
- Medical Literature
Linguamatics I2E natural language processing
- Medical Device
SARF semantic text mining
- Social Media
MedWatcher Social

Routine

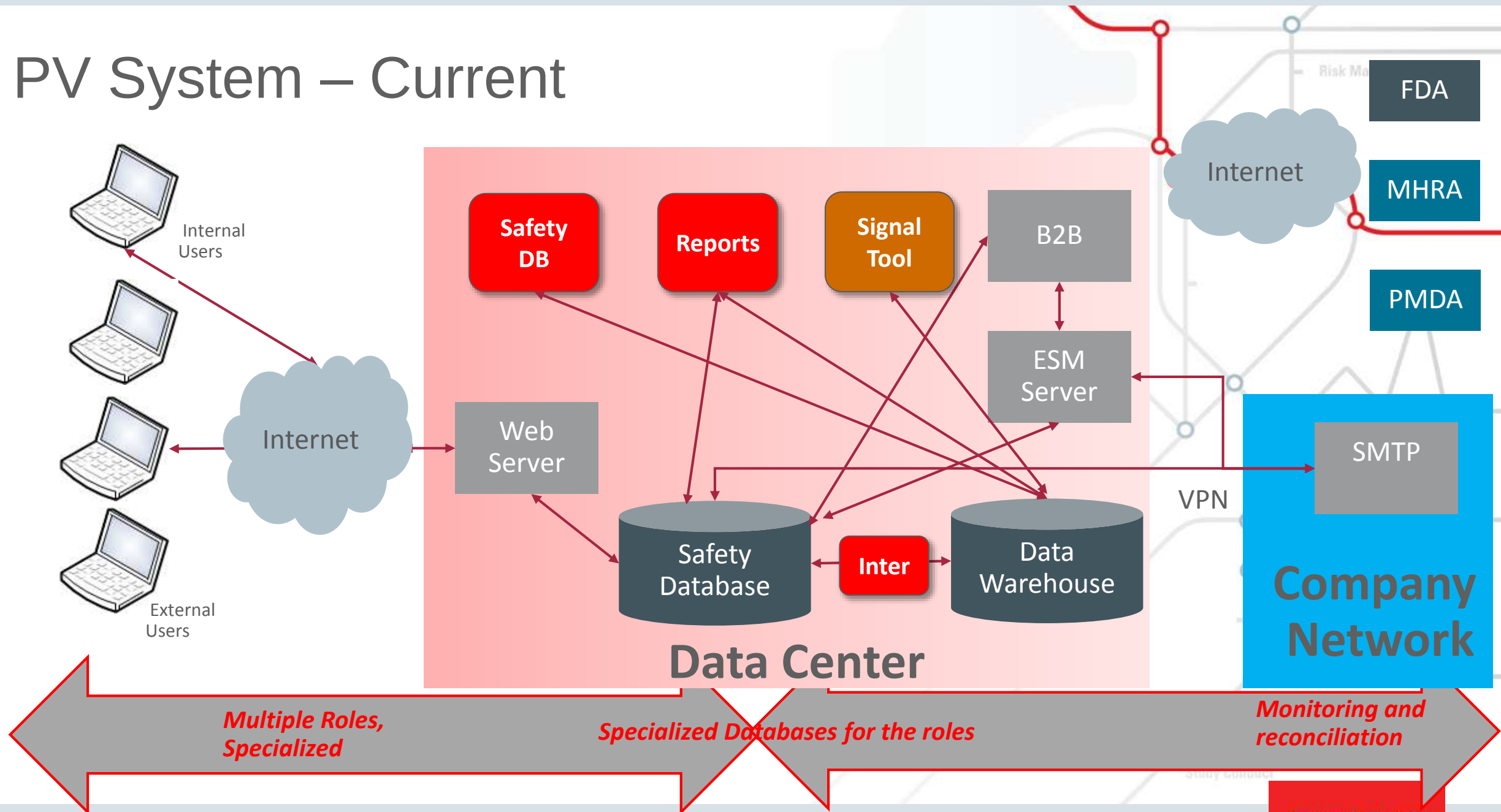
- Clinical data in NDAs
Empirica Study™
- CFSAN Call Center
SAS Enterprise Miner™

<http://www.fda.gov/downloads/ScienceResearch/HealthInformatics/UCM443675.pdf>

FDA Approach to Automation



PV System – Current

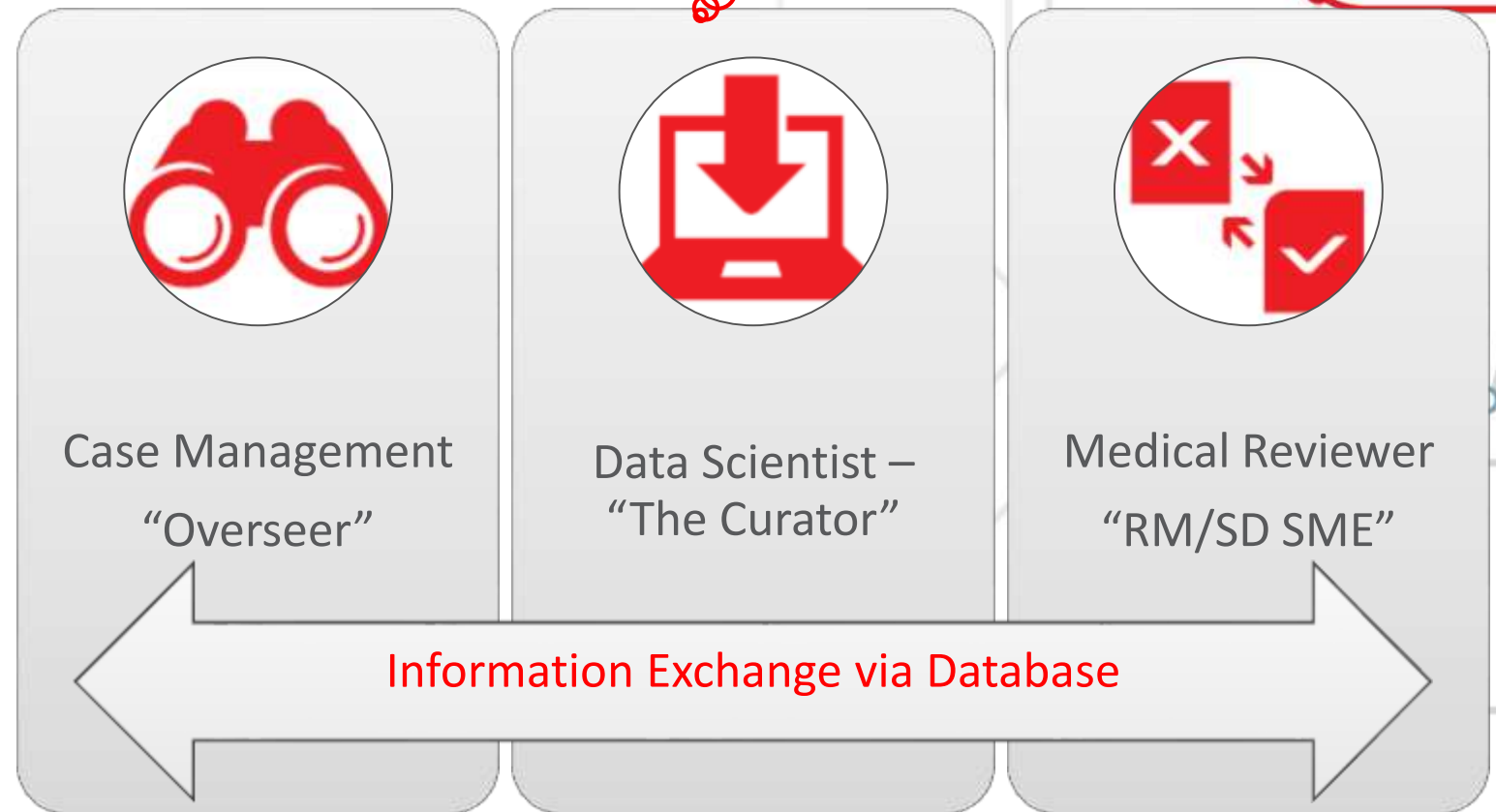


Future of Pharmacovigilance

Aligning workflow with technology efficiencies

Assumptions:

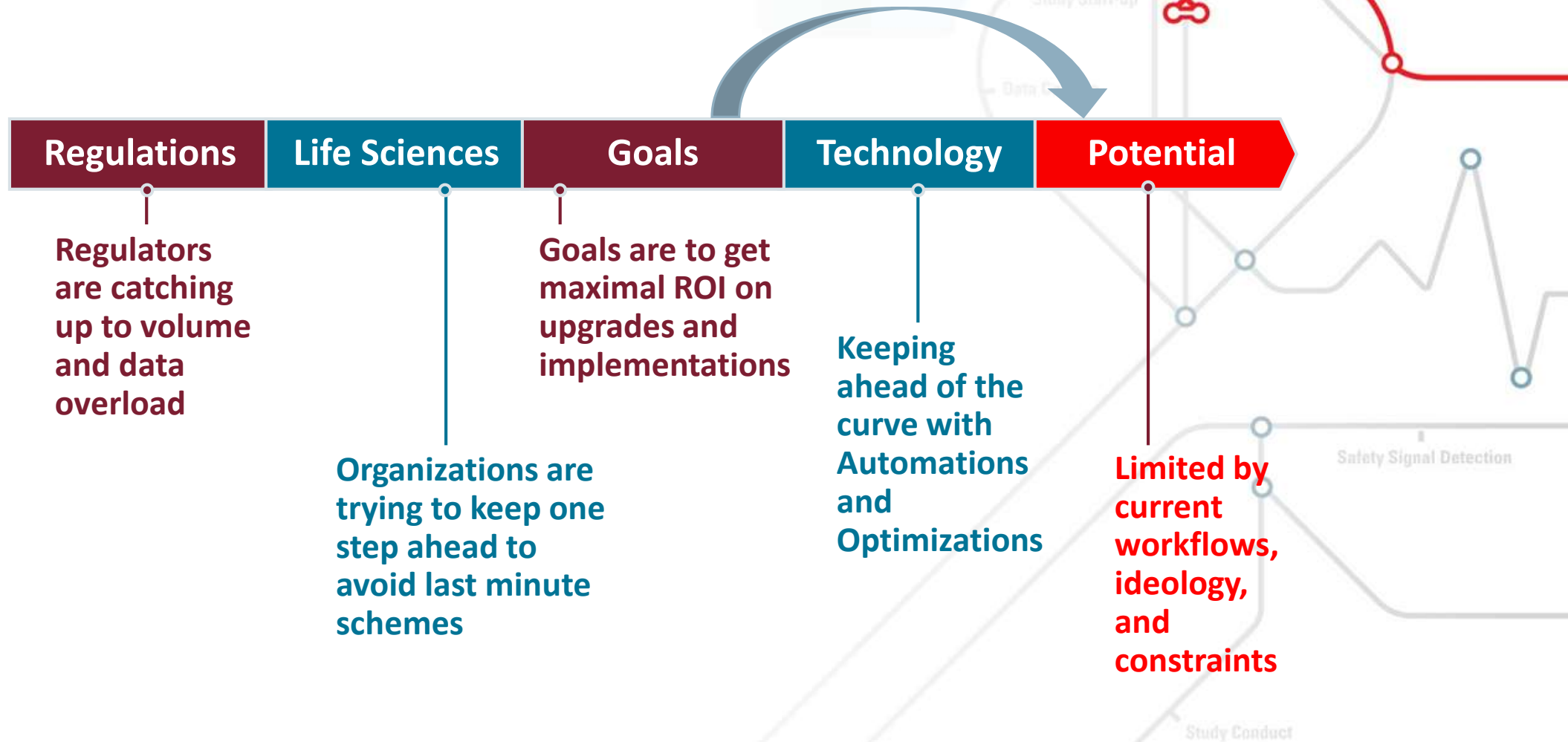
- Data overload
- Case volume overload
- ICSRs commoditizing
- Require automations to regain processing efficiencies
- Need for regulatory compliance



Progress Towards Transformation

Aim to achieve potential, not just goals

Timeline of Progress



Q&A

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